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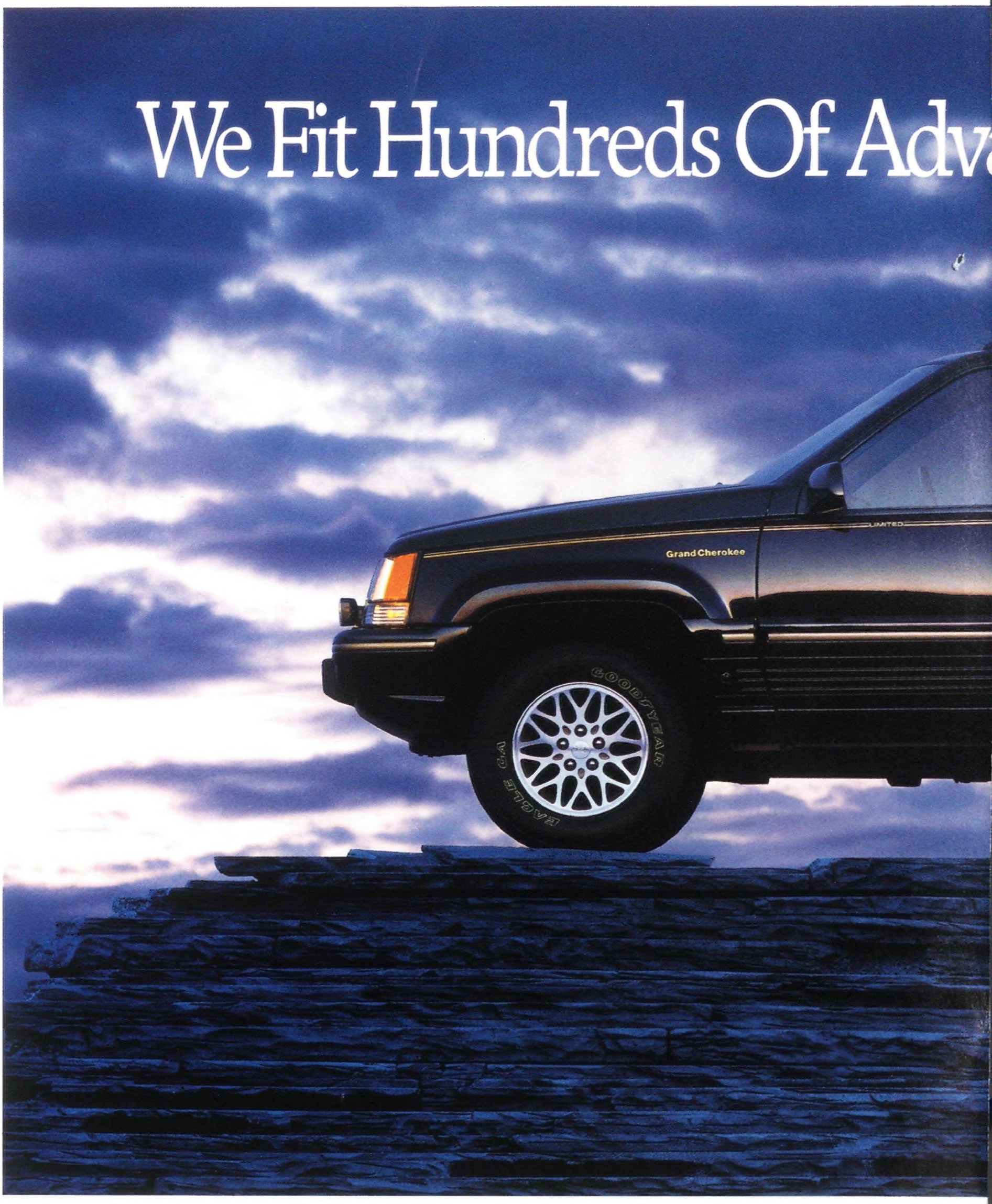

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October/November 1992
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Cover:
Photographer Irina Mikhailovna Kuznetsova captured writer Tom Harpole (middle) and Sergei Kiselov in a pre-jump pose before a ski-equipped Antonov An-2.

Departments

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"If you want to grow old as a pilot, you've got to know when to push it, and when to back off." *Chuck Yeager*

Throughout his remarkable career, Chuck Yeager has shown an uncanny talent for what pilots call "pushing the edge of the envelope." At 21, only three years after boarding his first plane, Yeager was leading a squadron of fighter pilots in World War II. And at the age of 24, he became the first person to fly faster than the speed of sound.

Attempting such dangerous feats is one thing. Living to describe them to your grandchildren is another. Displaying the enormous courage, skill and cool judgment needed to do both has made General Chuck Yeager an authentic American hero.

Although retired from the military, Yeager remains a man on the move. He's an avid sportsman with a lifelong love of the outdoors, a lecturer and a consulting test pilot who still loves to fly. "Maybe I don't jump off 15-foot fences anymore," said Yeager, "but I can still pull 8 or 9 G's in a high-performance aircraft." And in all his exploits, Yeager depends on a rugged and reliable timepiece. "I wore a Rolex 40 years ago when I broke the sound barrier and I still do today," says Yeager matter-of-factly. "A pilot has to believe in his equipment. That's why I wear a Rolex."

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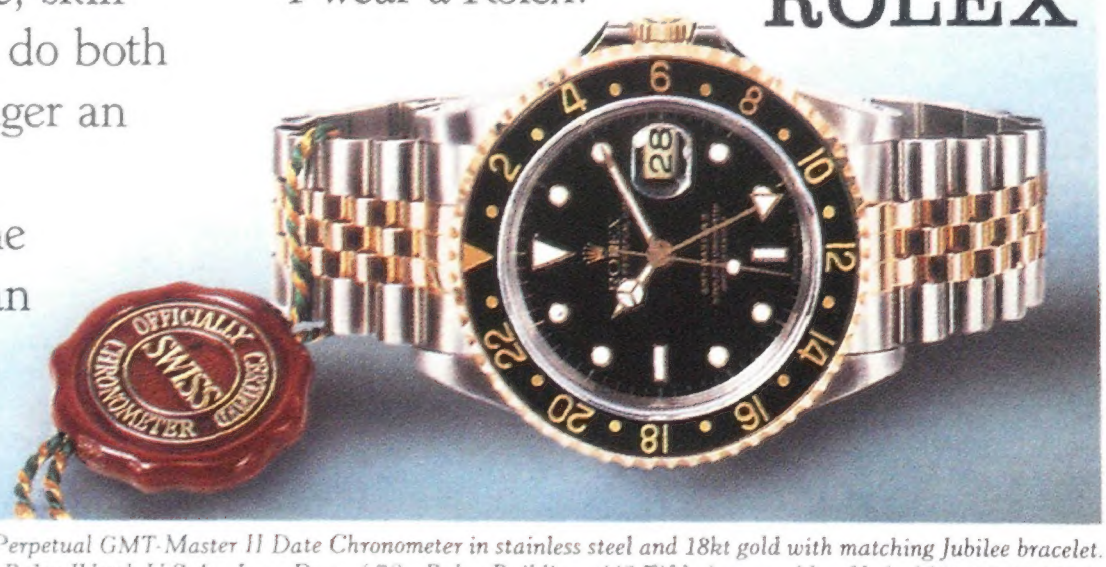

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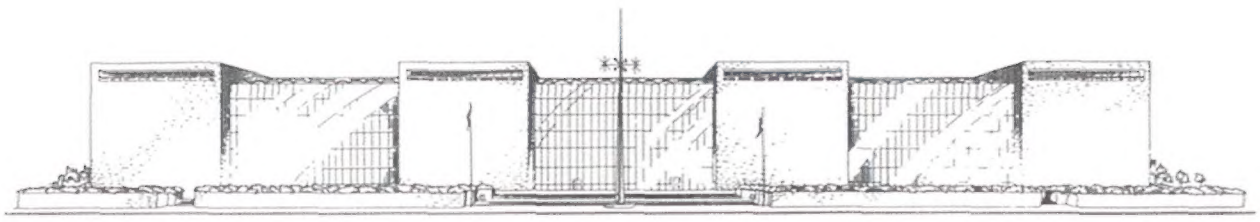

Oshkosh

I went to Oshkosh late in July for the annual fly-in.

What an experience!

Tens of thousands of aircraft, small and large. Hundreds of thousands of people all there because they love flying. Whole villages of campers springing up overnight. Instructive workshops to help you hone your skills with a torch, saw, needle, or wrench.

Historic fighters and bombers from World War II. Ingenious homebuilts of peculiar design, some constructed with wood and fabric, others metal, and the most recent from modern, lightweight materials.

And then the hours of spectacular aerobatics! Unbelievably skilled pilots, precision flying, courage, and discipline all rolled into one.

Despite the crowds, the flow of airplanes as well as cars is regulated well; traffic moves along with no jams and few accidents. The grounds are also remarkably clean. Despite the millions of soft drinks consumed, no paper cups or aluminum cans roll around the area.

All of this is an enormous tribute to the Experimental Aircraft Association; to Paul Poberezny, the father of it all; his son Tom, who now has taken over the reins; and to the thousands of people who donate their time, often year after year, to make the week in Oshkosh the enormous success it is.

With all this skill and enthusiasm where does the future lie? Where are we headed?

It's hard to tell. Almost as overwhelming as the number of aircraft was the number of participants in their late 60s and early 70s—the World War II generation, the first to grow up with airplanes. Many came with their grandchildren. But I thought I noted a marked generation gap in between, possibly those who grew up with heroes like Glenn and Armstrong rather than Lindbergh and Doolittle.

Given that gap, can we count on a smooth continuation of the traditions of Oshkosh, passing the heritage of small airplanes and private pilots on to future generations? And what reasons are there for pressing for that continuity? What has made flying so captivating to us? What are we hoping most to preserve?

Is it the sense of exhilaration only those of us who have been fortunate enough to learn to fly can experience? Or the ability to roam around free from the standard routings dictated by an age of mass transportation? Or the sense of beauty and unity of nature, gained from our bird's-eye view high up above the hills and valleys? Or the playful spirit of man, set on breaking away from Earth's gravity?

In an era of mass production, few opportunities remain for carrying out a project truly from start to finish. One of the attractions of flying is the ability of one human, working all alone, sometimes for years, to build a machine that against all apparent odds can propel him or her into a private world shared only by aviators. This is the thrill of adventure, which I hope we will never outgrow.

Flying is not just transportation, though many will stoutly defend the importance of general aviation as a practical means of getting from here to there. But even if, someday, the needs of efficient mass transportation were to place insurmountable obstacles in the way of the individual pilot and general aviation as we know it ceased to flourish, I'd like to think there would be other worlds to conquer, perhaps out in space or deep down in the oceans. And people would apply diligence, courage, and ingenuity to build their own machines and cruise through those worlds for new glimpses of nature and private insights shared by only a dedicated few.

Flying has a fascination for girls, boys, and their grandparents, not because it provides conveyance but because it goes far beyond. Flying is a way of life that speaks to the human spirit. I believe that's what Oshkosh is all about.

—Martin Harwit is the director of the National Air and Space Museum.

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Letters

Name That Plane, Please

Nothing I have read lately has given me both joy and a burdened heart the way your article "The Name Game" did (August/September 1992). We have sunk to new depths if simply giving a military airplane a nickname involves government bureaucracy—and probably plenty of taxpayer money. I can see that the nickname should fit the aircraft, but this process is mere warthogwash! Companies are capable of naming their own aircraft, a cheaper, less time-consuming process. After all these years, why can't the F-111 be named Aardvark? Puh-leeze!

R. Keith Sisk
Forest City, North Carolina

Regarding the selection of a name for the Air Force's new Advanced Tactical Fighter, I propose the F-22 Superior. Not only is this moniker suggestive of the air superiority mission of this aircraft, it also symbolizes the high level of aeronautical expertise incorporated into its design. However, if Congressional budget cutting should continue, the name for the de-scoped version of this fighter may have to be changed to the F-22 Superficial.

John Foley
Greenwich, Connecticut

Congressman Robert Dornan might want to think twice about naming the B-2 bomber Shadow, since Dodge builds a car by that name. As an official name for the B-2 or any other stealth aircraft, I suggest Spectre, if it's not already taken.

David A. Hawk
Wilkes-Barre, Pennsylvania

I was a B-52 electronic warfare officer during the 1960s. Those of us who flew the D model in Southeast Asia came to rename it HAPS—High Altitude Plowing System—for the tons of earth turned over by our missions.

Murray H. Siegel
Fountain Hills, Arizona

"This is NOT the time, Peters, for flight simulation."

The Rockwell B-1B Lancer? Has everyone forgotten the Republic P-43 Lancer, which flew in World War II?

Martin Caidin
Gainesville, Florida

Little Green Men

I really enjoyed the article "Aliens in the Basement" by Frank Kuznik (August/September 1992). I served at the Wright-Patterson base hospital from 1979 to 1981 and received my early education as a bureaucrat there. As a result, I can offer an educated guess as to the fate of the missing "little green men" of Wright-Patt.

1. Those actively involved with the little green men got old and retired.

2. A brigadier general wanted more lab/office space for his organization.

3. A colonel was sent to scout possible lab/office space that could be expropriated for the organization. The little-green-men storage facility was nearby.

4. The colonel sent a tech sergeant to pack the little green men in boxes and clear the storage facility. The sergeant labeled the boxes "stuffed toy animals, condition poor" and sent the boxes to the surplus property warehouse.

5. A civilian rag dealer bid on the boxes of little green men, took delivery, and discovered they smelled bad. The rag dealer then took the boxes to the landfill and discarded them.

If you think my story is implausible, you should visit the surplus property warehouse at Wright-Patterson and ask the staff how to bid for surplus items. You might even find used flying saucer parts, but they won't be accurately identified in the catalog.

James R. Niederlehner M.D.
Roanoke, Virginia

Anyone who studies the UFO phenomenon from 1947 on notices a very clear pattern. Multiple reports of the same objects from highly qualified scientists, radar operators, airline pilots, and military and police personnel attest to their existence. The ground crashes, similar descriptions of the aliens, and now the many stories of abductions all leave little doubt in the minds of people who believe that we are constantly being visited by UFOs from other planets. This shouldn't be so surprising since NASA hopes to do the same thing eventually. One of these days the UFO story will be the biggest one. As a former Naval Air Corps pilot, I'm glad to see that you have come of age with this exciting subject. Many good

publications suddenly get silly when writing on this subject, so please continue to keep us informed in a serious and technical manner.

Alan L. Hausman
Port Washington, New York

The events that took place near Roswell, New Mexico, in July 1947 are well documented. The question is no longer if something happened, but what happened, and why is it still being hidden 45 years later. Colonel (later brigadier general) Thomas J. Dubose was the chief of staff of the Eighth Air Force, the parent unit of the 509th Bomb Group, at Roswell in July 1947. He has said repeatedly, on audio and video tape, that the balloon explanation was designed to "get the reporters off Ramey's back" (Brigadier General Roger Ramey, commanding officer of the Eighth Air Force). In other words, one of the officers who was there has said that the balloon explanation was nothing more than a cover story.

There is also Brigadier General Arthur Exon, who was later the base commander at Wright-Patterson but who was a lieutenant colonel at Wright Field in 1947. On audio tape, he has said that many of the people at Wright Field believe the debris recovered near Roswell was extraterrestrial. He also described his own flight over the crash site, telling us that he saw the gouge created when the craft crashed, as well as the tire marks of the military vehicles that had driven over the field.

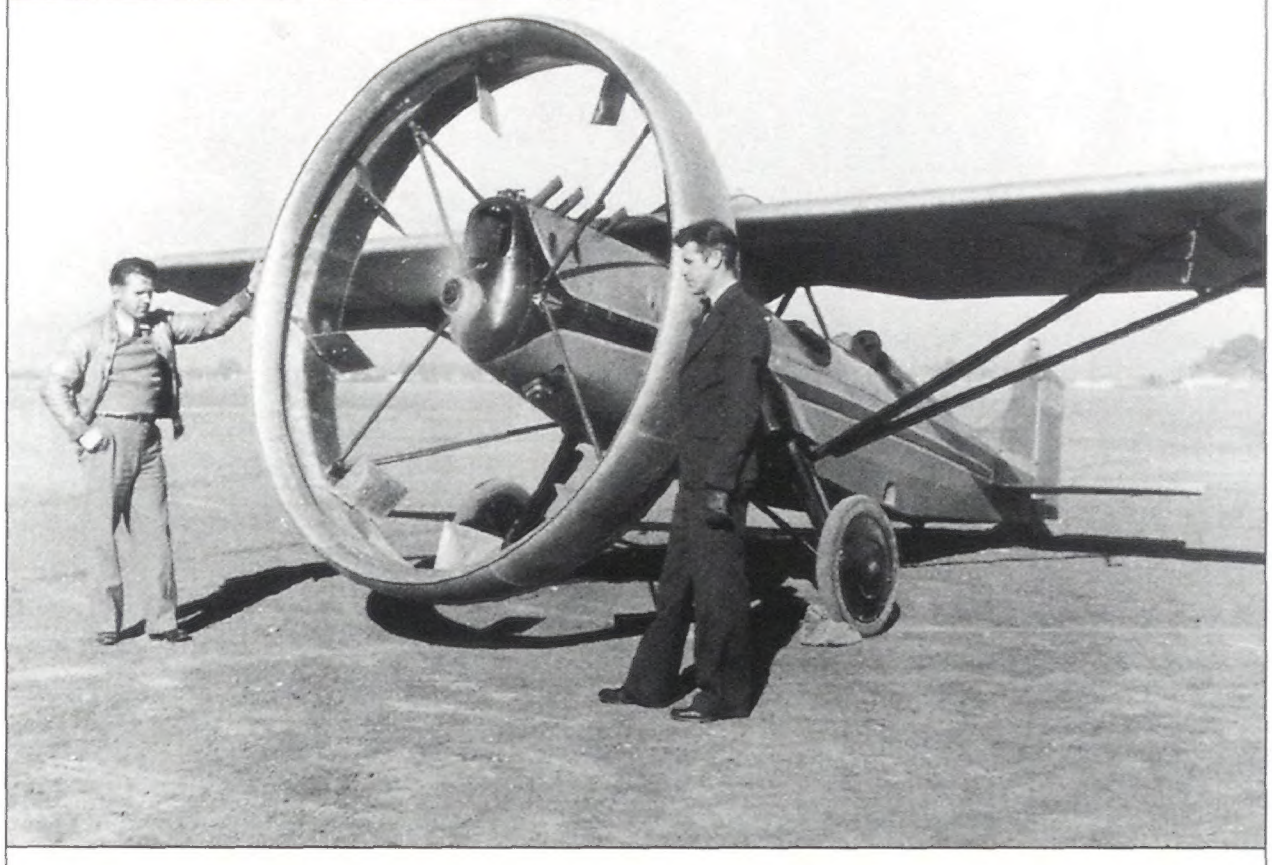
Here are two sources who seem to confirm much of the Roswell tale. Both talk of aspects of the case about which they can provide firsthand testimony. There is much more about this that must be explored. I believe the debris was extraterrestrial, but in any event, it is clear that something more than a balloon was recovered near Roswell.

Kevin D. Randle
Co-author, UFO Crash at Roswell
Cedar Rapids, Iowa

It is illogical that an extraterrestrial civilization perhaps a million years more advanced technologically would design and build spacecraft that can crash.

M.M. Kazanjian
Chicago, Illinois

Unidentified Flying Object



Can you identify the aircraft in this photograph? From time to time the National Air and Space Museum's archives division receives photos of vehicles that its staff cannot identify. They would appreciate any help in identifying this monoplane, which may be a Peterson & Campbell single-seater, registration number X-12273 (the tail number is too indistinct to identify with certainty). The two men standing in front are identified as Carl N. Hall and Frank C. Nixon, although we don't know which is which. The large ring was designed to deflect air into the propeller and improve performance. This photograph appeared in an April 1933 issue of Popular Aviation. *If you can solve the mystery, send your response to:* Air & Space/Smithsonian, *Department ASP, 370 L'Enfant Promenade SW, 10th Floor, Washington, DC 20024.*

Last issue's photo was identified by a total of 22 readers. A detailed history of the airplane was provided by Allen J. Wiltz, who is on the board of directors of the Wedell-Williams Aviation Museum in Patterson, Louisiana. He writes: "The unidentified flying object is the second aircraft built by the Wedell-Williams Air Service Corporation in Patterson, Louisiana. Construction began in February 1930 of an aircraft that would serve as a fast mailplane if a government contract could be secured. In August, the aircraft was slightly modified: the front cockpit was closed, wheel skirts were installed, and a Townsend Ring cowl was added." Thus outfitted as a racer, the aircraft was given the racing number 92 and the name "We-Winc." In 1932 Jimmy Haizlip flew it to victory in the Bendix Trophy race. Other popular—though incorrect—responses included a Travel Air Mystery Ship, a Ryan PT-22, and a Spartan C2-60.

Fake Flamingos

Looking at the photograph on page 16 of the August/September 1992 issue, I wonder if the flamingos melted into the ground as *Endeavour* rose into the evening sky?

Gregory E. Custer
Mequon, Wisconsin

Amelia: The Mystery Remains

This fellow Gillespie seems to specialize in foggy logic ("Amelia Earhart: Is the Search Over?," August/September 1992). Defending his dramatic media pronouncement that the mystery has been solved, he makes an analogy to the theory of evolution, which he says science has proven. His proofs of Earhart's crash are about as secure as science's proofs of evolution. As for the flight, once Earhart had made the almost incomprehensible decision to leave behind her trailing antenna for low-frequency transmissions, her chances of finding Howland Island were reduced to a matter of pure luck. That day she didn't have it. The only mystery is just where she splashed down. So who cares?

David H. Rust
Houston, Texas

Stephan Wilkinson castigates TIGHAR's critics for dismissing specific evidence

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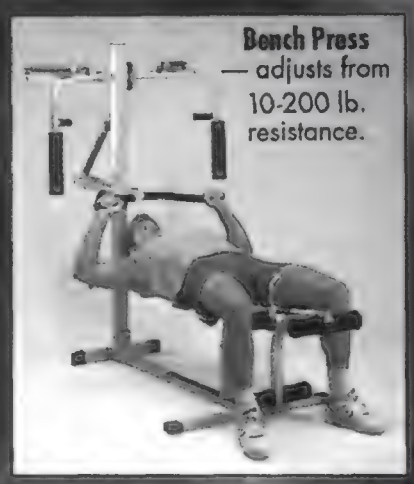

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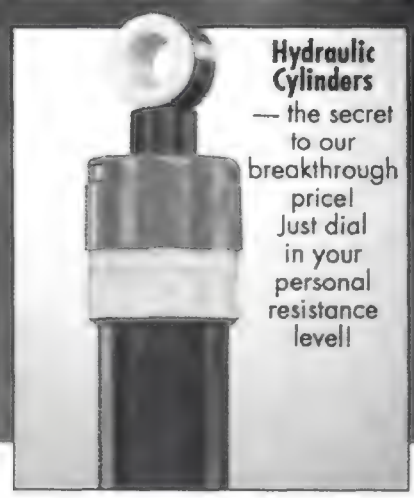

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Another Crop Duster's Tale

In the early 1950s I was averaging $150 a day working as a crop duster around Shreveport, Louisiana. I flew a Stearman biplane powered by a Pratt & Whitney 250-horsepower engine. I'd take off before sunrise carrying 1,000 pounds of DDT, a poison that wiped out boll weevils before they wiped out the cotton crop.

One evening, my girlfriend Dorothy and I drank and dined at the Pelican Landing, one of the city's nicer spots. It was after midnight before we left the club, and close to 2 a.m. before I turned in. I'd been up since five the day before and felt more than a bit worn out. At 4:30 a.m. my phone rang. I ignored it. It kept ringing. Finally I answered it, more asleep than awake. It was my boss. He wanted me out at the airport on the double.

Without thinking I said, "No way. I just got in from partying. I've had no sleep and I'm drunk."

"You get out to the airport in 10 minutes," said my boss. His words hit me like shots from a gun. I checked the clock and countered, "Goddammit, if you wanted me to fly, why didn't you tell me yesterday?"

"If you want to fly for us, you'll be out at the field. You savvy?" he said. Again I told him that I wasn't in any shape to dust crops.

"If you want your job, you better get your ass out to the landing strip ready to fly," he barked. "Crank up the green Stearman, you hear?"

After a moment of silence, I gave in and started getting ready for a hop in a plane I'd never flown. I was damn near shaking from too much to drink and not enough sleep. Driving out to the airport, I felt condemned. I was thinking that I should have told the boss to take the hop himself and jam the job sideways. But against logic I kept going, feeling doomed.

As I neared the landing strip, I saw the green Stearman. I parked my pickup and checked the plane. It was gassed and loaded with poison. Experienced pilots will not believe that we idiot duster pilots would untie the plane, take the chocks away from the wheels, turn the ignition on, set the throttle a notch above idle, walk in front of the plane, and pull the propeller through four or five times till it revved up. Then we'd dart around the left wing and pull the throttle back before the plane started to roll too fast. I had to do it to keep my job, which paid more in one day than most workers earned in a month. (Remember, we're talking about the lean '50s.)

I got the green job going, climbed into the cockpit, strapped myself in, and, after warming it up, took off into near-darkness. (We often did a lot of dusting before sunup because there was little wind then.) I found the field and circled it. On the thousand acres I saw telephone poles. It was too dark to see the wires. My boss had told me that a flagman would be 30 feet back from the lines on the swath I'd be flying. I spotted the flagman and banked for my first run. When I got to the flagman, I dove toward the cotton. Back then, we flew with our wheels touching the cotton for maximum poisoning effect.

Suddenly and too late, I realized that the flagman was standing under the telephone lines. I flew into them. The poles on either side were rotted and snapped apart; the lines wrapped around my plane like strands of spaghetti. In a tenth of a second, I crashed into the ground at 80 mph.

I remember calling out to God to let me live and then I blacked out. The force of the impact tore the engine loose and set the green Stearman on fire. The remainder of the plane hurtled upside down for over 50 yards before smashing into the field.

I came to. I couldn't see anything and I thought I was blind. I unbuckled my safety belt and climbed out from beneath the burning plane and ran as fast as I could through the tall cotton. Exhausted, I fell to the ground with my head bleeding. After a while, I removed my goggles. I could see. (The goggles had been smoked over.) The flagman ran up. Thinking I was dying, he was too frightened to talk.

I got up. As I walked away, I noticed a deep drainage ditch less than 10 feet away from the tail assembly. If the tail had gone into the ditch, I would have been trapped under the plane and would have burned in the wreckage. How stupid I was to take the hop. I ended up with three atrophied disks and an arthritic spine. But I was lucky to be alive.

Fred Getchell
Austin, Texas

with speculative generalizations. Then he turns around and does the same thing himself. The material found on Nikumaroro is not generic junk that can be used to construct a fanciful tale. It is, instead, narrowly defined debris that dictates its own rules to anyone attempting to explain it away. Ockham's razor, correctly stated, holds that "entities are not to be multiplied beyond necessity." In applying this principle to the evidence found on Nikumaroro, the specific nature of the artifacts is the necessity that the entities are not to be multiplied beyond. For example, musings that the aircraft skin found there might be from "an Air Corps fighter or a Navy cargo plane" fail to allow for the fact that the labeling on the aluminum is unlike any style used during World War II but is exactly like that on an existing Lockheed 10 just three serial numbers from Earhart's.

At the end of the article Wilkinson quotes biologist Thomas Huxley: "The great tragedy of science [is] the slaying of a beautiful hypothesis by an ugly fact." The beauty of TIGHAR's hypothesis is that, despite the speculation that has been hurled against it, no ugly fact has yet risen up to slay it.

Richard E. Gillespie
Executive Director, TIGHAR
Wilmington, Delaware

Wild Times at Willow Run

Don Sherman's terrific article "Willow Run" (August/September 1992) revived many memories. I was a co-op engineering student at the University of Detroit in June 1941 when I was hired as a draftsman on the B-24 project for 65 cents an hour, 10 hours a day, seven days a week. Before Willow Run was completed, drafting was done in one of the hangars at Ford Airport where the Tri-motors were once built. In the adjacent hangar, where the lavatory was located, Henry Ford Sr. stored antique farm machinery, which he puttered with almost every day. His stock answer to our "Good morning, Mr. Ford" was "How's the airplane coming?" Later, at Willow Run, we found the security most inefficient. My college chum carefully hand-lettered an official-looking windshield permit that allowed us to park in the executive lot. Naturally, we kept the windshield dirty. The same enterprising individual altered his ID badge photo by adding a forelock and a small black mustache. Until we graduated in 1944, no one questioned his Hitler image. As aero engineering students, we often used

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–Gene Roddenberry

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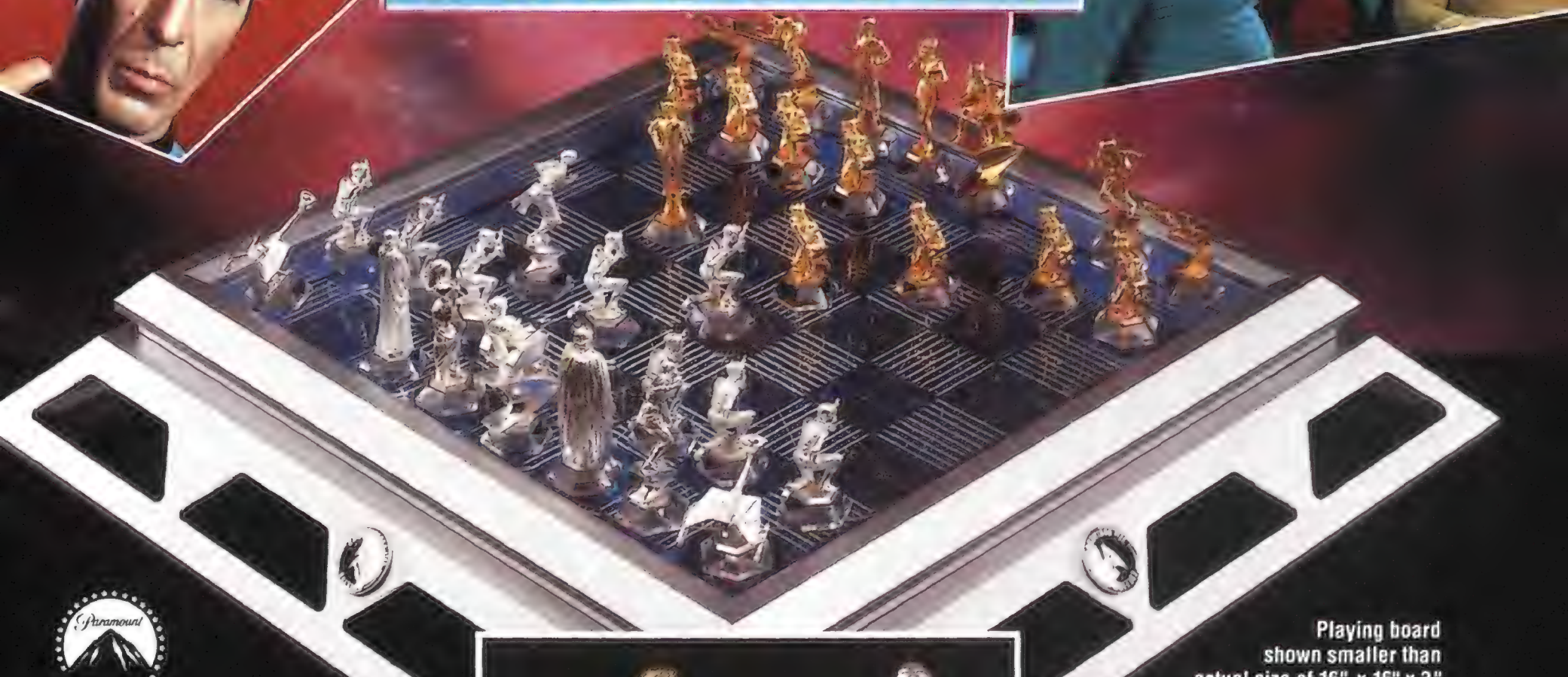

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George M. Galster
Naples, Florida

Even though I joined the workforce just prior to World War II, I didn't know about the Willow Run operation. Working 12 hours a night plus attending aircraft mechanics' school full-time during the day left me little time to spare. But after reading Don Sherman's article, I was greatly impressed by the magnitude of the integrated effort that was applied there. The Willow Run workers were certainly more productive than most of today's "keypunching" generation, which seems to spend a fifth of its time correcting errors in the frantic effort to meet deadlines without thinking. Small wonder our country's output lags behind that of other nations.

Roland Klemm
Pleasant Valley, New York

In 1944 I was assigned to serve as a copilot flying a B-24 out of Willow Run. While the engines were starting up, the engineer came running into the cockpit and said, "Let's get the hell out of here! There's gasoline spraying all over the place!" Needless to say, we cut everything and bailed out. It turned out that one of the gas lines was not connected. Despite what the log said, we wondered if that plane had ever been test flown.

Ray C. Frodey
Fremont, Michigan

The First Aerial Bomb

As Tom Huntington pointed out in "That's Entertainment?" (June/July 1992), there is considerable doubt as to who showed the first in-flight movie, but I don't believe it was Britain's Imperial Airways in 1925. According to the *New Orleans Times-Picayune* of August 28, 1921, the movie *Howdy Chicago!* was shown aboard the hydroplane *Santa Maria* at an altitude of 2,000 feet. When I excitedly phoned a historian at the National Air and Space Museum with this news three years ago, he responded with a pained yawn. I presume *Howdy Chicago!* did no better—at the box office or in the air.

Jamie Bisher
Hyattsville, Maryland

The Heart of an Astronaut

I work at the Marshall Space Flight Center at a facility where some of the shuttle astronauts train in Spacelab simulators. While I don't work directly with the astronauts, I have become familiar with some and speak with them from time to time. After reading "The Beach House" by Mike Mullane (June/July 1992), I viewed these special people in a very different way. Mullane's writing provided a rare, tasteful view into the astronauts' lives, telling us of the emotions they feel on the eve of a launch. Before I read this piece my attitude toward them had been somewhat cavalier. I saw them as celebrities, and though I knew they had dangerous jobs to do, I never stopped to consider that they were just as human as I am. Mullane has opened a window into their hearts.

Scott Paulson
Fyffe, Alabama

Star Trek Dreamers

In "Why Star Trek?" (Viewport, August/September 1992) Martin Harwit writes: "Why is the Star Trek fan movement still so strong even today? The answers aren't at all clear...." The answer is that there are people out here who still dream. Star Trek is about as close as most of us will ever get to space travel. Unfortunately, most of our illustrious members of Congress are not capable of such dreams. For every major aerospace, space, or research science project, there are many who want to see them terminated. I'm talking about the aerospace plane, space station Freedom, the supercollider, and the Earth Observing System. If these programs don't survive, then our already meager science and math education scores will continue to plummet. We must continually strive to go where none have gone before; otherwise, we face a boring future. The longer we wait, the tougher it will be.

Richard Boydston
Deming, New Mexico

Correction

We inadvertently omitted a byline in the Reviews & Previews section of the August/September 1992 issue. The review of *Aces* was written by Tom Huntington.

We welcome comments from readers. Letters must be signed and include a daytime telephone number. Letters may be edited. Write to Air & Space/Smithsonian, *370 L'Enfant Promenade SW, 10th Floor, Washington, DC 20024.* Air & Space *is not responsible for the return of unsolicited photographs or other materials.*

PBS is producing a biographical documentary on Amelia Earhart and is interested in hearing from people who knew her at any time, who met her airplane when she landed, or who were in any way influenced by her. Reminiscences, anecdotes, photos, and home movies are welcome. Please send your name, address, and phone number to: The Amelia Earhart Documentary Film Project, 955 Massachusetts Avenue, #267, P.O. Box 9183, Cambridge, MA 02139.

Berlin Homecoming

The Berlin airshow—formally, the ILA '92 Berlin-Brandenburg International Aerospace Exhibition—touted as the world's oldest airshow, returned to its *heimatstadt* last June after a 64-year exile.

For its debut, the new, improved Internationale Luftschiffahrt-Ausstellung got a lift from a hot-air balloon shaped like Berlin's most famous monument, the Brandenburg Gate. Three-quarters the size of the original, the show's mascot floated grandly over admiring spectators. Its mission: symbolize the new Berlin, a union of East and West.

Mission accomplished, according to Michael Meier of Schindler & Parent, the admen who dreamed up the balloon. "When the Germans saw it, they cried," says Meier.

The balloon had a secondary mission: tour the world and drum up interest for the new show, one of the most important trade fairs since the fall of the Wall. First held in Berlin in 1912, the ILA played here most recently in 1928. After World War II it moved to Hanover, where its last appearance there in 1990 drew a mere 85,000, the smallest crowd in German airshow history.

ILA '92 was not without its growing pains. There was some lack of organization—yes, even in fabled Germany—but it was forgivable. "One year ago," said spokesman Willy Rogell, waving at the new show grounds at the south end of Schönefeld Airport, 40 minutes from downtown Berlin, "there was nothing but runways here—no water lines, no telecommunications, no electricity. We started with grass." Schönefeld was a restricted area before the Wall came down. There were no roads, no water, and no entry in a three-mile zone surrounding that infamous structure. ILA's race against the clock got help: the chalets came from Le Bourget's Paris airshow, giving the Berlin event more than the usual dose of trade show déjà vu.

The ILA went to great lengths to bring safety to Schönefeld. Says flight director Dieter Thomas, "We analyzed previous accidents, like Ramstein, and imposed our own restrictions based on that." Those restrictions were pretty heavy. So was the 25-page safety brochure, which banned overflying of the crowd and formation aerobatics. Only low-noise aircraft could fly during the mid-day break, so as not to rattle wineglasses in the chalets. All aircraft, Thomas says, had to alter their exhibition plans to comply with the new rulings, stricter than those at any other show.

Despite the wrinkles, attendance was good, though many companies predictably waited out this first go-round. No Italians showed. McDonnell Douglas and Boeing passed, as did Dassault. But of the nearly 300,000 visitors and exhibitors (not bad for recessionary times), 75 percent said they'll be back.

—Joshua Jampol

The Russians recently informed the U.S. Department of State that should cosmonauts need to make an emergency landing outside of the former Soviet Union, their first choice would be the northern United States. At the Berlin airshow, a Soyuz TM spacecraft displayed at Russia's exhibit had the following instructions painted on its sides and bottom:

1. Attention! Not to Stand Near This Side!
2. Take the Key!
3. Put Into the Hole! Turn!
4. Open the Hatch!
5. Help to go Out!

Update

Name Dropping

Russia's Baikonur Cosmodrome has recently been renamed Tyuratam for the town nearest to the launch site ("Disaster at the Cosmodrome," December 1990/January 1991). For some 30 years the cosmodrome had been called Baikonur for a town 160 miles to the northeast in an attempt to disguise its location.

The T Is for Time Clock

They don't make airplane programs like they used to. Time was when a new trainer came along you'd fly it to an air base, invite a couple of generals to wring it out, and then everyone would repair to the officers' club to sign the papers. Not anymore.

The appearance of one candidate for the Air Force-Navy Joint Primary Aircraft Training System (JPATS) at Andrews Air Force Base in Maryland last July was emblematic of what's changed in military procurement: the centerpiece of the presentation was an airplane with its wings cut off. The Lockheed-Aermacchi-Rolls Royce MB-339A "maintainability demonstrator" made it clear that its backers understand how the Department of Defense buys airplanes. Today, selling an airplane to the military depends as much on how well it impresses the accountants as it does on how sweetly it performs a wingover.

Both the Air Force's Cessna T-37 twinjet trainer and the Navy's Beech T-34C turboprop trainer are getting old. Although the Air Force pursued the Fairchild T-46 as a replacement throughout the late 1980s, the troubled program was finally canceled, leaving the Air Force with a primary trainer fleet whose average age is 29 years. The two services were told to select a single aircraft that would serve their primary training needs until 2025, and eight candidates (interestingly, all of them foreign designs) have lined up to compete for one plum among a dwindling number of military contracts. Although no dollar value has been assigned to the program, it calls for 417 Air Force trainers, 348 for the Navy, and all the simulators and equipment that go with them.

The winning trainer will have to demonstrate its performance, of course, but it will also be judged by operating costs for its entire service life, and that includes not just flying but maintenance and repair as well. So Lockheed and Aermacchi, an Italian firm that builds the MB-339, travel with the grounded version of the airplane, which they've named the T-Bird II (in hopes of evoking warm memories of the Lockheed T-33), to demonstrate how quickly key maintenance can be performed. The manufacturers' objectives are to show that any engine-mounted accessory can be changed in one hour and that a complete engine can be replaced in three.

At Andrews, they also brought along a model that has wings and can fly. Things haven't changed *that* much.

—George C. Larson

ROLLS-ROYCE

NASA Gets Its Colors Done

If a new broom sweeps clean, then Daniel Goldin, NASA's new administrator, is a regular Dustbuster. And as part of his crusade to revitalize and streamline the agency, last May he resurrected NASA's old insignia, a busy circular design known as "the meatball," to replace the current "worm" design in minimalist lettering.

"The can-do spirit of the past is alive and well," Goldin declared in a speech at NASA's Langley Research Center in Virginia last July. "It seems only fitting that the original NASA insignia...be part of our future." Overnight the design that emblazoned spacesuits on the moon—the blue circle featuring heavenly bodies, an orbital path, and the agency's name and country—reappeared on lapels, news releases, and NASA TV broadcasts.

Judging from the reaction, you'd think Goldin had changed the formula for Coke. Many of the Apollo-era employees rejoiced over the return of the meatball ("Everybody loves it," enthused one engineer), but some younger workers prefer the worm. Others view the old insignia as a graphic travesty. The National Endowment for the Arts, for example, threw a fit. Mina Wright Berryman, director of the NEA's design arts program, accused NASA of "jeopardizing its entire visual communications program" by retiring the worm design. Selected in 1975 by an NEA-supervised panel of graphic artists, the insignia earned the space agency a

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*Based on a February 1991 USA TODAY reader poll. **Supplemental Restraint System. Always wear your safety belt

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WHAT A LUXURY CAR SHOULD BE

presidential award for design excellence and eventually got carved on the building that will serve as NASA's new Washington headquarters.

Goldin intends the switch to symbolize his push for faster, cheaper, and more productive ways of exploring space. He directed employees to phase in the meatball as they replenish supplies, rather than throw out stationery and repaint vehicles. "For those concerned about frugality, zap! You're empowered," he wrote in a memo. "Go out and buy your own business cards."

"I'm still waiting for the first order," says one printer who gets a lot of jobs from Florida's Kennedy Space Center. "I think a meatball is more dynamic than a worm, but I'm not getting rid of it. If I keep it long enough, they'll go back to it. I have confidence in our government."

—Beth Dickey

CHAD SLATTERY

Honey, I Shrunk the Stealth: A larval F-117 was recently sighted in the Fontana, California driveway of Lockheed aircraft inspector Henry Rosales, who says he built the plywood model for his kids. The mini-Stealth comes equipped with "authentic jet sound," exterior lighting, and nosewheel steering. "It's presently people-powered but a self-propelled upgrade is being seriously pondered," writes Rosales.

Update

Automated Dusting

A miniature unmanned helicopter is fast becoming the vehicle of choice for crop dusting in Japan ("This Is Bobby Yon, Altha Air Service," August/September 1992). Some 200 of the 10-foot-long robocopters are being used to spray rice fields at sites and in weather too treacherous for pilots.

Astronauts on the Rocks

William Muehlberger's office wall looks like a rogue's gallery of space travelers. "Would you buy a used car from this man?" he asks, pointing to a glaring, unshaven John Young. Sally Ride looks like a campus radical, with bare knees poking through holes in her ratty jeans. "She spent hours sitting in this office talking about geology," says Muehlberger, a professor emeritus of geology at the University of Texas at Austin. "She'd always show up wearing a T-shirt and jeans with the knees out. She looked like half the students around here."

Muehlberger, who for 30 years has coached astronauts on the land and ocean features they view in orbit, snapped the less-than-heroic poses during field trips to New Mexico. Hardly any of today's astronauts have taken geology courses, he says, "so they don't know a damn thing about it." To close that gap, he ferries each new class of shuttle astronauts, a van-load at a time, from Santa Fe to Taos, Chama, and Los Alamos on a four-day tour that introduces them to extinct volcanoes, ancient sand dunes, glacier footprints, and canyons that slice through millions of years of rock deposits.

"He's great," says Kevin Chilton, who piloted *Endeavour* on its first flight earlier this year. "When I went on the field trip he was in his early 60s, and he was guiding a bunch of people in their early 30s. He walked us up and down the mountains, talking the whole time, but he had us huffing and puffing."

Muehlberger, a tall man with a crushing Texas handshake and an easy smile, has retired from the daily grind but continues his plate tectonics research and astronaut training program, which began in 1964. Back when money was plentiful at NASA, Muehlberger organized grand safaris for the Apollo astronauts—two-day tours through Big Bend National Park in west Texas that showed them what to look for on the lunar surface. He was also the principal investigator for the Apollo 16 and 17 field explorations and helped train Skylab crews. Today, he briefs shuttle crews before their missions on what to look for, such as fault zones in New Zealand and southern Turkey, and helps select the best Earth images from each flight.

The geologist says that most of his space-bound students are good learners. "All but one have been eager as hell," he notes. "But there was one…I'll never identify him. It was in the midst of the World Series or something, and he was much more interested in that than in learning any damn geology."

—Damond Benningfield

Update

Air Race Redux

A new air race will debut in Edinburgh, Texas, next March with a purse equal to Reno's and a course that can accommodate the Unlimited class ("The Last Piston Show," April/May 1992). Sponsored by the California-based Galaxy Group, an aviation engineering and research organization, the Gordon Cooper Air Races are named after the Mercury and Gemini astronaut, a Galaxy executive.

Comet Missions: Buy One, Get One Free

When the Giotto spacecraft was launched by the European Space Agency in 1985, its sole mission was to rendezvous with the famous comet Halley. As it flew through Halley's coma in 1986, Giotto measured dust and gas, took the first close-up photos of a comet, and sent back volumes of information. Sandblasted by comet dust, Giotto's instruments began to fail, but of the 11 on board, eight endured. "For the craft to survive as it did was icing on the cake," says Ian Pryke, head of ESA's Washington, D.C. office.

Giotto did more than just survive. ESA put the probe into hibernation after its close encounter and sent it past Earth in July 1990, throwing Giotto into a new trajectory that would allow it to ambush Grigg-Skjellerup, a comet that visits the

FRED JONES/NASA

A number of NASA employees lined up to commemorate the 75th anniversary of Langley Research Center in Hampton, Virginia, last July. Construction of Langley Field, the first home of NASA's predecessor, the National Advisory Committee for Aeronautics, began in 1917. In 1985, five Langley creations—three wind tunnels, a rendezvous docking simulator, and a lunar landing research facility—were designated national historic landmarks. Langley's latest aerospace contribution is the diminutive HL-20 lifting body-type transport for space station crews.

inner solar system every five years.

Awakened last May, Giotto swung within 124 miles of the comet's 1.9-mile-diameter nucleus on July 10, while 133 million miles away, NASA's Deep Space Network listened for the whisper of signals the craft sent back. Although the imaging camera was damaged, the remaining instruments gathered loads of data on Grigg-Skjellerup's dust, plasma, gases, and magnetic fields.

"We've been able to provide an additional science mission at very low cost," says Pryke, "and it was different from Halley." Grigg-Skjellerup is much older than the adolescent Halley and could tell us more about the early solar system.

And Giotto is still in one piece. Pryke points out that because Grigg-Skjellerup was more benign than Halley, Giotto was considerably less sandblasted the second time around. But Giotto's second mission was its last—the spacecraft is down to a few pounds of fuel. It's been put back into hibernation and will not near Earth again until 1999.

—Patricia Barnes-Svarney

Update

The Number You Are Calling Is Out of Service at This Time

A 7.4-magnitude earthquake in Southern California last June knocked one of NASA's Deep Space Network antennas out of service for five weeks ("Long Distance Calling," August/September 1992). Other antennas compensated, but the loss of the 64-meter antenna at the Goldstone tracking station temporarily reduced data collection from Magellan, Ulysses, and the Pioneer and Voyager probes.

Dinner Takes Off

On the third Thursday of every month, you may have to stand in line a while for dinner at The Bodacious Barbecue on Division Street in Arlington, Texas. That's when the restaurant hosts an informal, motley group of mostly men who gather to talk about airplanes. Organized by Jay Miller, owner of the Arlington-based aerospace publisher Aerofax, Inc., the evening begins with a heaping plate of Texas barbecue, cole slaw, and pinto beans.

But the real fare is served up after dinner. The audience of three or four dozen comes to hear a talk by a pilot, aircraft designer, or military analyst that Miller digs up from his network of contacts. North Texas, home to two big airlines, three major aerospace contractors, and several Air Force bases, has one of the largest pools of aviation talent in the country.

One might hear Phil Oestricher, the F-16's first test pilot, describe that maiden flight ("hard to land," he recalled with characteristic test-pilot understatement). Or Dave Peters, a former SR-71 pilot, recall a flame-out at Mach 2 ("Control can be tricky," he said). Or Jim Hannigan, one of the designers of the X-6 nuclear-powered aircraft, talk about why the program was canceled in 1961 ("The engines weighed 10 tons each").

The audience may comprise a DC-10 captain, the principal designer of the F-16, and F-14 pilots from the Dallas Naval Air Station—fliers and engineers who want to hear more than press-release puffery about airplanes and programs. Test pilot Oestricher, for example, revealed to his audience that the Grumman F9F Panther

he flew in the Navy could hold two dozen Christmas presents in addition to its normal load of bombs (there was a little-known compartment between the nose radar and the cockpit). The SR-71, on the other hand, was not only cramped but thirsty. A typical mission required the services of three KC-135Q tankers.

A "guess the airplane" session often follows the speaker's presentation, during which photos of some of the world's oddest flying machines are shown to the audience, usually accompanied by a trivia quiz. Is that a Convair "Pogo," poised on its tail for takeoff? How about this picture: a Grumman Goose, Mallard, or Widgeon? And which one of the trio is the oldest? How many were built? How many are flying today?

Anyone who answers incorrectly is apt to be the butt of jokes for months. Just as each of the Bodacious birdmen remembers the stall speed of the last airplane he flew, each relishes a chance to poke fun at his friends. And he never forgets where to land the third Thursday of every month.

—Byron Harris

The cobalt-blue circle in the center of this gaudy mosaic, produced from Magellan data, is a one-mile-high Venusian volcano straddling a fracture. The rich colors are a measure of the radio waves emitted by geologic formations, with red at the top of the scale and blue at the bottom. Magellan images indicate that on Venus, the higher the surface, the lower the emissions. Scientists at California's Jet Propulsion Laboratory, where this image was produced, speculate that in some cases the presence of minerals such as pyrite may be partially responsible for the phenomenon.

Tilt!

Talk about timing. After two crashes of Bell-Boeing V-22 Osprey tilt-rotor craft—*and* the more recent loss of the XV-15 prototype in an accident in Texas—anyone hawking a machine with the word "tilt" in it might be expected to remain below the radar for a while. But the Ishida Aerospace Research group of Fort Worth, Texas, is at pains to point out, while playing down any rivalry, that tilt-*wing* aircraft are a completely different proposition. At a press conference in Washington, D.C., last August, the company, a U.S. affiliate of Ishida Corporation of Nagoya, Japan, confirmed its application for Federal Aviation Administration certification of an aircraft designated TW-68. ("TW" stands for tilt-wing; the "68" is utterly meaningless. "There have not been 67 previous designs," a company official said.)

Whereas the Bell-Boeing machine rotates its wingtip-mounted engine-rotor assembly to the vertical in order to hover, the TW-68 will pivot its entire wing more than 90 degrees from the cruise position to the vertical. A major difference between the two designs is that the Osprey's rotors are similar to a helicopter's, while the tilt-wing's four engines are paired through a transmission to drive two 16-foot propellers, which can't control the machine in all three axes. The tilt-wing therefore has a small ducted fan on its tail to control its nose-up/nose-down motion in pitch.

Research tilt-wing aircraft have flown before, but have never been developed commercially. Though the TW-68 has yet to fly anywhere but in a computer, plans call for a first flight in 1996 and a type certificate in 1998. The company plans to accomplish all this while remaining lean—a "skunkworks operation," says engineering coordinator Tom Gardner.

Borrowing from another prototypical aerospace corporate configuration entirely, vice president of engineering John D. Stowe said that Ishida was seeking partners to form an "Airbus-style consortium." At the press conference, the engineers handled the technical questions, but when journalists asked about such weighty matters as money, the technoids deferred to Shoichi Sugiyama, who quoted a unit price of $7.5 million to $8 million. He also elaborated that "Airbus-style" meant "international," not "government-backed." Apparently, the only contact Ishida wants with any government agency is when the FAA hands over a type certificate.

—George C. Larson

Matinee Idling

The National Air and Space Museum is one of the most popular museums in the world. It is also one of the least intimate. Because many of the artifacts are massive, the spaces that surround them are big, open, and, especially in the summer, full of people. It's usually no problem to stroll through the exhibits at your own pace, but rarely are you alone with the airplane or spacecraft you've come to see. Occasionally the crowds at the Museum can wear you down a little, and you find yourself craving a quiet room somewhere off the beaten path. A few weeks ago I found that room, in the middle of one of the Museum's most popular exhibits.

What I happened on was a tiny movie theater in the World War I gallery. Furnished simply with three rows of carpeted bench-style seating and some Art Deco light fixtures, the theater is as dim and welcoming as a favorite neighborhood bar.

About every 20 minutes, the theater shows a terrific little documentary called *Hollywood Knights of the Sky*. Narrated by a dapper, elderly Douglas Fairbanks Jr., the production, which is subtitled for the hearing-impaired, features clips from assorted Hollywood features about the Great War, including a few that have been shown in the Museum's current World War I Lecture/Film Series (see Museum Calendar).

NASM

The documentary leads off with a clip from *Wings*, a 1927 silent film about two young men who love the same girl and who both end up flying in the war. One hero "had always longed to fly...in every day-dream he heard the whir of wings," while the other is an F. Scott Fitzgeraldesque fellow from "the wealthiest family in town." The flying scenes are both thrilling and hilarious: the combatants, filmed head-on, look as if they are riding some fiendishly overpowered roller coaster. Then there's Richard Dix and Elizabeth Allan in *Ace of Aces*, which features this impassioned exchange on the question of enlisting—

Hero: "I just don't like the idea of killing my fellow man for something I'm quite sure that he hasn't done. Sort of a moral scruple."

Heroine: "Moral scruple! This is no time for moral scruples! Everyone must make a sacrifice now!"

Most of the clips are from features produced in the 1930s; Fairbanks points out that during the Depression, Americans were ardent moviegoers. And perhaps a belief in the nobility of sacrifice, a theme common in these nostalgic treatments of World War I, held a particular appeal to Americans during those bleak years.

Still, the movies weren't unrelievedly jingoistic. *The Dawn Patrol*, originally made in 1930 with Douglas Fairbanks Jr. and remade eight years later with David Niven, includes a potent dose of anti-war sentiment. Recovering a lost aviator's helmet and gloves, a commander tells his unit: "...a very gallant gentleman died this afternoon. And for what? What have all these deaths accomplished? So many fine chaps who have died in this war and are going to die in future wars...."

Even visitors whose interest in World War I runs a distant second to an interest in movie stars will find something charming or at least memorably silly in *Hollywood Knights of the Sky*. There's the effervescent Jean Harlow in *Hell's Angels*, who manages to heat up the whole screen just by breaking into a grin. There's Joan Crawford grimly pedaling a bicycle alongside Gary Cooper in *Today We Live* ("I thought the war was silly too," he tells her; "I never believed in it till now"). And there's Fred Astaire and Ginger Rogers in their last movie together, *The Story of Vernon and Irene Castle* ("Is it terribly dangerous in those planes?" she asks. "I mean, worse than in those trenches?" "Darling, we said we wouldn't talk about it tonight," he says soothingly.)

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—Perry Turner

Museum Calendar

Except where noted, no tickets or reservations are required. To find out more, call Smithsonian Information at (202) 357-2700; TDD: (202) 357-1729.

October 3 Monthly Sky Lecture: "Beyond Columbus." Don Costanzo, National Capital Astronomers, and HAL 9000, the computer from *2001: A Space Odyssey* and *2010,* will debate the future of space exploration. Einstein Planetarium, 9:30 a.m.

October 8 General Electric Aviation Lecture: Chuck Yeager will recapture the drama of breaking the sound barrier. Langley Theater, 8 p.m.

November 10 Children's Program: "Apollo to the Moon." A multi-media show in which actor Kevin Reese portrays a young astronomer in the 1960s who dreams of going to the moon. Einstein Planetarium, 7:30 p.m.

November 12 General Electric Aviation Lecture: "Just Plane Smart." Herbert Kelleher, chairman of Southwest Airlines, will discuss why Southwest received the lowest number of passenger complaints in a 1991 government survey. Langley Theater, 7:30 p.m.

Attention Researchers

Because of building renovations, the NASM Archives and Library will be able to serve visitors only by appointment beginning in November. Reference requests requiring access to certain parts of the collection may be delayed for six to eight weeks. Requests for technical manuals and drawings will *not* be affected.

The new address for all archival reference: National Air and Space Museum, Archives Division (MRC 322), Smithsonian Institution, Washington, DC 20560. The address for library reference: National Air and Space Museum Library (MRC 314).

Artifacts

Visitors to the Museum pass by one of two monumental sculptures as they enter: Continuum *(left), a curvilinear bronze sculpture by Charles Perry, based on the concept of matter turning in on itself in a black hole, or* Ad Astra *by Richard Lippold, worked in nickel stainless steel.*

LEE BATTAGLIA

Delta Solar *by Alejandro Otero is a kinetic steel sculpture set on end in a pool of water at the Museum's west end. A gift from the people of Venezuela, the sculpture's frame suspends triangular sails that turn in the slightest breeze.*

"Once Invisible"—Space Age Astronomy Lecture Series
All lectures will be held in the Einstein Planetarium at 7:30 p.m.

October 15 "Cosmic Discovery." NASM director Martin Harwit on the relationship between astronomical discoveries and new instruments and techniques.

October 22 "Gamma Rays, Microwaves, and the Big Bang." Robert Kirshner, Harvard University, on results from the Cosmic Background Explorer and Compton Gamma Ray Observatory.

October 29 "Cosmic Surprises from Hubble." Eric Chaisson, Harvard-Smithsonian Center for Astrophysics, on the origin and evolution of the universe.

November 5 "Magellan's Circum-navigation of Venus." John Wood,

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Harvard University, on the mapping of Venus.

November 19 "The X-Ray Sky from Einstein to AXAF." Harvey Tananbaum, Harvard-Smithsonian Center for Astrophysics, on the mission of the Advanced X-Ray Astrophysics Facility, planned for launch in 1999.

World War I Lecture/Film Series

October 13 Lecture: Lynne Hanley, Hampshire College, on gender and World War I historiography. Langley Theater, 7:30 p.m.

October 23 Film: *La Grande Illusion*, Jean Renoir's classic about the escape of two French aviators from a German prison camp. Langley Theater, 8 p.m.

October 27 Lecture: Cole Palen, Old Rhinebeck Aerodrome, on World War I aircraft. Langley Theater, 7:30 p.m.

October 30 Film: *Von Richthofen and Brown*, a 1971 movie contrasting the attitudes toward war of a German aristocrat and the Canadian farmer who flew against him. Langley Theater, 8 p.m.

November 6 Film: *Paths of Glory*, a 1957 movie directed by Stanley Kubrick and starring Kirk Douglas. Langley Theater, 8 p.m.

November 10 Lecture: George Mosse, author and co-editor of the *Journal of Contemporary History*, on air supremacy. Langley Theater, 7:30 p.m.

Star Trek How to Obtain Passes: The exhibit will run through January 31, 1993. All visitors, regardless of age, must have passes to enter. Free same-day passes (four per person maximum) may be obtained at the Museum. Advance passes may be obtained for a fee through area Ticketmaster outlets or by calling (800) 551-7328. For recorded information, call (202) 786-2122.

Museum Seminar Registration opens in November for "Mutual Concerns of Air and Space Museums," March 8–12, 1993. For more information, call (202) 289-9113.

Museum Visits For a free planning packet, write Smithsonian Information, Smithsonian Institution, Washington, D.C. 20560, or call (202) 357-2700. Daytime parking near the museums is limited; visitors are urged to use the Metrorail subway system.

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Sitting on Top of the World

The situation looked grim. There I was, on the flat, white, 10,000-foot-thick expanse of ice in Greenland, about to be snowed in for God knows how long. A Lockheed C-130 Hercules transport was ready to fetch me but the weather was too bad for flying. I had come to Greenland with the ski-equipped cargo planes of the New York Air National Guard, and they had to get back to Schenectady in two days, with or without me.

The Guard pilots practice Arctic operations in case they have to resupply forces in such climes, and since the contiguous United States is short on Arctic environs, they fly to Greenland, which has plenty. To do something useful while practicing, they carry supplies to remote scientific camps on the ice. Being primarily weekend fliers, they can't stay.

Fine. But I had decided to stay overnight at one of the camps and get the next morning's flight back. And then the weather closed in.

Sondrestrom, an airfield to the south, called every half-hour to see if we had clear skies. A Danish ice scientist dutifully ran out each time to measure visibility and wind velocity. Marginal, he kept reporting. The scientists, a dozen or so dedicated souls living in tents in sub-freezing temperatures, are quite helpful to the Guard because without it, they don't eat. In fact, they have developed into a sort of cargo cult, worshipping the squat green noisy god called Hercules.

Finally, the sun peeked through the lowering murk. We radioed the news to Sondrestrom, and two C-130s took off in our direction. I stood waiting in the absolute dead silence of the ice cap and watched the air scintillate with ice crystals. Hundreds of thousands of years' worth of ice stretch, featureless, off to the eerie jumbled regions where it wrinkles, breaks, and falls into the ocean.

The 109th Tactical Airlift Group flies ski-equipped C-130Hs, the latest model of the Hercules, which may join the DC-3 as an indestructible aircraft. According to the 109th, they cost about $18 million each; skis add, incredibly, another $10 million. The skis are actually skids with holes in the center to allow wheels to be hydraulically lowered, enabling the airplanes to land on either snow or asphalt.

But the pilots don't, alas, make instrument landings on the icecap. I prayed for clear air.

Two hours later, when the Herks radioed that they were nearing our area, a hole opened up in the clouds. Then the plan fell apart. A pair of scientific German gypsy caravans had chugged out of the bleak vastness and begun crossing the runway (a runway on the ice cap consists of a stretch of snow in which the scientists promise not to dig pits). The Germans, doing some kind of research that required them to wander around a lot, had rigged up a sled with a red plastic igloo, a

DAVID CLARK

preposterous thing in which to live. They had linked it, along with four other sleds piled high with equipment, to a snow tractor, and now were driving two such convoys across the landing strip. Swell. Trapped on the ice by a traffic jam. There was no landing on that pass.

When the gypsies finally wandered out of harm's way, a C-130 dropped through the clouds. It roared and howled and threw up big plumes of snow as it set down. And promptly got stuck. Some 23,000 pounds of cargo will do that in soft, fresh snow.

I clambered onto a snowmobile, crossed the couple of hundred yards to the airplane, and climbed up to the flight deck to find out what was going on. The crew was cheerful; these guys weren't easily perturbed. "Okay, gang," the pilot said laconically, "let's see if we can blast her loose."

"Roger that," said the copilot, shoving the throttles forward. The craft shuddered and bucked and moved not one inch. Three tries produced identical results. We were well and truly stuck.

"Try cycling the landing gear," said the pilot. The idea was to lower the wheels through the skis in the hope that they would hit hard ice beneath the snow and force the skis upward. Sometimes it works.

The effect was startling. The flight deck slowly rose and fell, rose and fell, like some winged green sumo wrestler ceremoniously bowing in the snow. But there was no forward motion at all.

"I'm open to ideas," the pilot said, leaning back and looking thoughtful.

"Put boards under the wheels?" someone eventually suggested.

"Yeah, boards. I guess." In many respects the problems of C-130s are similar to those of the family car.

We radioed the scientists, who came out with their tiny stock of timbers and dug them under the wheels, and then we tried cycling the gear again. The boards snapped like twigs.

"Maybe 136,000 pounds of airplane is a bit much for two-by-fours," said the pilot. "Guess we gotta unload."

Normally, to avoid getting stuck, these airplanes keep taxiing after touchdown while the crew throws the cargo off the tail ramp, which makes the craft look like fat insects laying eggs while they crawl. Denied that option, we rolled pallets of fuel, food, and equipment off the tail one by one and waited while the scientists dragged each one away with a tractor. Meanwhile, the horizon was getting fuzzy. The weather was closing in again.

It worked! We shook loose at last. But by now the horizon was rapidly disappearing, and without one in this white and featureless land, you can easily drag a wing during takeoff or landing.

We taxied to the end of the runway, happy at the thought of soon being anywhere else. "Call off the speeds, will you," the pilot asked the copilot, "so I'll know when to go."

We went to full power on the monster turboprops and tried to take off for a good five minutes. The snow went by faster and faster and the C-130 surfed majestically up and down, the snow not being perfectly flat but undulating slightly.

"Twenty knots," the copilot said. "30, 35, 40…40…40…40…." We surfed on for another couple of minutes. "Goddamnit," said the pilot, "if we don't make it soon I'm going to 100 degrees flaps and set out across the open snow."

He wasn't kidding. This is established procedure, to the extent that anything up there is established. The entire ice cap is a runway until you reach the fissures at the edge. These airplanes have taxied 60 miles in search of a patch of hard snow.

"All I can think to do is take her back to the start of the runway and try again over the same tracks we made this time," the pilot said. "Maybe we packed the snow down enough to get off."

Well, it sounded reasonable, but so do many things in the Arctic—and in the military—that never work. We turned around and undulated back.

We wound up the engines something fierce, determined to attain flying speed if we had to stick our legs out and paddle. Again, we set out along the snow.

"Thirty knots…40…40…45…50…."

"We're gonna make it," the pilot said, almost as if he believed it. As soon he could he lifted the nose ski off the snow to reduce friction. The trick is to lift it just short of the point that it increases drag. Sixty knots. 70. And we were airborne, climbing through dense fog. In these parts, you work for your flight pay.

—Fred Reed

Slightly Irregulus

In the 1950s the annual airshow at the Naval Air Missile Test Center at Point Mugu on the Southern California coast drew thousands of civilians to gape at various high-performance aircraft and missiles. As a technical advisor on cruise missile and aircraft engines and the man assigned to cover the introduction of the McDonnell F3H-2 Demon fighter-interceptor at Point Mugu, I knew that such shows could tend to get out of control. The test center was a real hotbed of sometimes unpredictable activity, and with all the ordnance on hand, cool heads had to prevail to prevent an accident.

Among the performances scheduled for one show in the late 1950s was the launch of an unmanned Grumman F6F Hellcat drone, the launch and recovery of a Regulus I cruise missile, and the shootdown of another Regulus by a Sparrow III air-to-air missile fired from a Demon.

One Regulus was to fly southeast, parallel to the beach, about a half-mile off shore. A sharp and seasoned Navy commander was slated to come booming in from the east in the F3H at 500 feet, afterburner blazing, and fire his Sparrow III at it. He was cautioned, however, not to fly—or fire—over the crowd.

The commander took off and disappeared, loitering to the east while other aircraft performed. The sacrificial Regulus was launched and sent out to sea in a holding pattern, waiting for the cue to send it south along the coast. But after a few minutes the Demon pilot called in acute distress. He was having trouble with his cockpit heat valve, which seemed to be stuck in the full hot position.

Meanwhile, the F6F drone was launched. It got up to about 50 feet before nosing over and crashing on the runway. A second F6F was expeditiously positioned on another runway while the first burned fiercely. The crowd didn't know what to make of all this but, after realizing that there was no one aboard the crashed airplane, seemed pleased with the excitement of it all.

FELIPE GALINDO

The second F6F started down the runway but veered off into the dirt. It bumped along in the rough terrain, took out a couple of runway lights, bounced back onto the concrete, got airborne, veered right, barely cleared the airport perimeter fence, and crashed into a bean field. It too burst into flames. Two huge pillars of black smoke now rose into the afternoon sky.

The crowd seemed to enjoy it immensely. I'm sure many of the observers thought this comedy of errors was planned for their amusement. To add insult to injury, a county fire engine that raced out to the bean field to extinguish the second F6F had to sidestep a frolicking dog, which caused the truck to swerve smartly and roll over on its side. Fortunately no one, including the dog, was hurt.

The commander in the Demon called back, by now quite irate. He was nearly dying from the heat in the cockpit, he said, and explained that certain avionics were being damaged by the high temperature. (What he actually said was "The knobs on my !*&*#*! radio are beginning to melt!") He urged the schedulers to get on with the Regulus shootdown so he could land and get out of the damn cockpit before he was pan-fried in his own juices. However, in the interest of maintaining the schedule, he was ignored.

The Regulus that was supposed to land returned, lined up with the long runway. While the jaded crowd watched, the drag chute accidentally deployed before the missile touched down. The Regulus slowed, stalled, and crashed just short of the runway. Now there were three columns of smoke several thousand feet high. Point Mugu was beginning to look like a war zone.

About this time the overheated commander came screaming in unannounced and let loose a Sparrow III at the loitering Regulus, which was now flying parallel to the coast and just offshore. Children screamed in terror and adults, clapping their hands over their ears, were scared witless by the racket of the F3H engine in afterburner and the deafening launch of the Sparrow III, which roared directly over the crowd at about 300 feet.

Things were not going as planned. The commander, in his orange flightsuit, was done to a turn in the cockpit. (We later found that the radio knobs, made of heat-resistant plastic, had indeed melted.) The low pass of the F3H and its air-to-air missile had so devastated the audience that hardly anyone saw the Regulus take a direct hit from the Sparrow and plunge into the Pacific. Too bad—it was the only thing that had gone right all day.

It had been some show. The crowd lingered expectantly, though the scheduled events were over, the debris had finally settled, and the fires were nearly out. The situation was astutely summed up by a Navy officer standing along the runway as we surveyed the damage. "Jeez," he muttered, "what are we gonna do for an encore?" Not to worry. At Point Mugu, there was always something, scheduled or unscheduled, that would top it.

—O.H. Billmann

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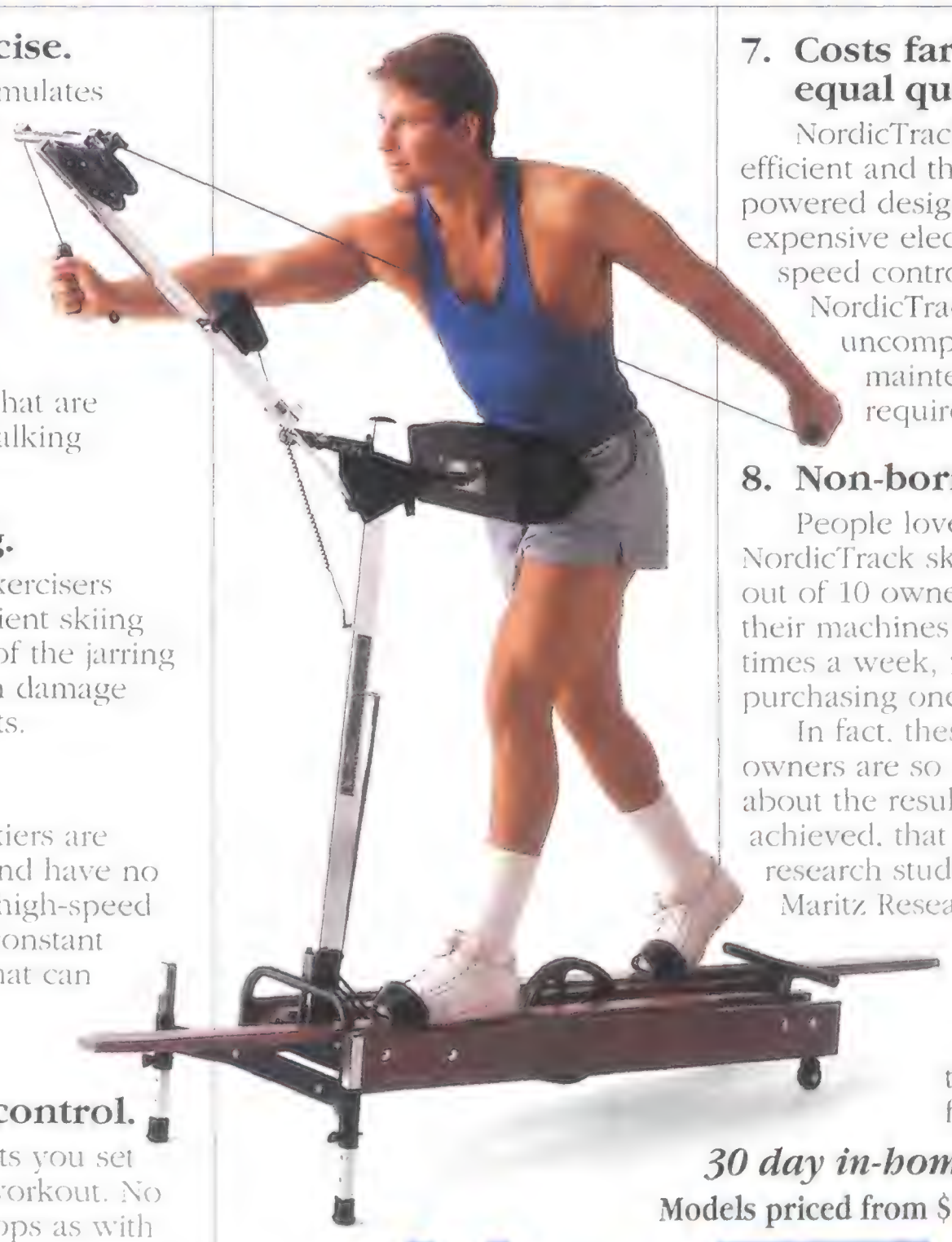

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In a series of popular-magazine articles summarizing the state of astronomy three decades into the 20th century, professor George Ellery Hale exuded confidence and pride. Understandably so. As director of Yerkes and later Mount Wilson Observatories, Hale had overseen construction of the world's largest telescopes, culminating in the great 100-inch Hooker reflector with which Edwin Hubble had first measured the distance to galaxies beyond the Milky Way. On Hale's desk were plans for a telescope that would dwarf all others, to be built atop Palomar Mountain in California. These instruments, along with a host of new techniques for analyzing light, had rapidly transformed astronomy from an occupation that involved little more than the dreary tabulation of star positions into astrophysics, a science that asked what stars were made of, where they came from, and where the universe was going.

At the close of the 20th century, we can look backward with no less pride. Three decades ago—even when viewed through Hale's great telescope on Palomar—the planets were little more than featureless dots. Today we have mapped Venus more completely than we have Earth, and snapped close-ups of the outer planets and their moons—many unknown until our spacecraft flew by. Three decades ago astronomical instruments were Earthbound. Today we have telescopes in space too, and our instruments are sensitive to a much wider spectrum of signals: X-rays, ultraviolet, infrared, and gamma rays. We have discovered pulsars and quasars, charted the galaxies out to billions of light-years, and detected the dying glow of the Big Bang at the limits of space and time. No wonder that Berkeley astronomer George Smoot, reporting in April 1992 that the NASA Cosmic Background Explorer satellite had found signs of embryonic galaxies in the radiation from the early universe, hailed our time as "the Golden Age of Cosmology."

Yet curiously, as we look forward to the next century, we find ourselves asking many of the same questions that Hale was investigating 75 years ago. Is Earth the only inhabited planet in the universe? How are stars and planetary systems born? What is the fundamental structure of the universe? How did it come into being? The details of the questions have changed, of course, for in Hale's time no one knew that the sun was powered by nuclear fusion, that white dwarfs and black holes could result from the deaths of stars, or that the luminous atoms clustered in stars were vastly outnumbered by some sort of invisible "dark matter" in the space between them. But the overarching questions of structure and origin in the cosmos have not changed substantially.

It is tempting to attribute this to some fundamental quirk in our approach to knowledge: we never seem to find ultimate answers, just more questions to tantalize us into looking deeper. But it is also true that astrophysicists, exhilarated by the promise of new tools, simply underestimated the difficulty of the research program that lay ahead.

At the dawn of the 21st century yet another generation of instruments is beginning to turn to the heavens. On the ground, new telescopes like the Keck 400-inch telescope on Mauna Kea in Hawaii and the European New Technology Telescope in La Silla, Chile, equipped with computer-controlled mirrors and solid-state detectors, are giving us clearer and deeper vision and showing us fainter objects. These mark the first incremental change in optical telescopes since Hale's Palomar giant went into operation a half century ago. In space, the Hubble Space Telescope (functioning well despite its well-publicized problems), the ROSAT X-ray telescope, the Compton Gamma Ray Observatory, and the Extreme Ultraviolet Explorer already afford us unprecedented views of the cosmos.

It is too soon to say whether these new instruments will provide satisfying answers to the big cosmic questions that have characterized astronomy since this century's beginning. What is clear is that working with them will bring us closer. "Astronomers...spend most of their lives in hard and often tedious routine work," Hale noted. "They are, however, sometimes fortunate enough to take part in a great adventure." A century after Hale watched the birth of astrophysics, a generation after astronomy moved into space, that great adventure continues.

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by Laurence A. Marschall

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Is there another Earth lurking somewhere in the universe? A handful of astronomers have mounted a scrupulous search.

by Billy Goodman

ASTRONOMY'S MOST WANTED

On a clear and cold April night, the University of Pittsburgh's Allegheny Observatory provides a spectacular view. The Big Dipper sparkles almost directly overhead. Jupiter shines from halfway toward the horizon. And brighter than anything in the celestial scenery are the gleaming office towers of downtown Pittsburgh, just three miles away, and the high-intensity lamps of Three Rivers Stadium, where the Pirates will play their home opener the following evening.

In the observatory, Steve Wagner and his partner Jim Kirby are on duty. They are part of a dozen moonlighting amateur astronomers who keep the observatory's 80-year-old telescope busy on every clear night in Pittsburgh, a city that was once dark at noon from the smoke of steel mills.

Every year one or two scientists announce the discovery of new planets, but no discoveries have survived further investigation.

Wagner and Kirby move without hesitation up the chilly observatory's staircases and along catwalks that leave a visitor groping for the next step. The two men work as a team, training the telescope at a succession of starry regions. Though the 30-inch Thaw telescope is one of the world's largest refractors, Wagner and Kirby know they won't see what they're looking for. Their targets—if they even exist at all—are so dim that they wouldn't be visible on the darkest night from the most remote mountaintop observatory.

Wagner and Kirby are looking for planets, but not the ones in our solar system. They are trying to detect worlds in orbit around stars other than our sun. They and the rest of the amateur observers are working to answer what is surely one of the great questions of our time: Are there planetary systems around other stars? Or are we alone?

Kirby is the floor man tonight. He prepares the electronic instrumentation on the telescope's tailpiece for each observing run and keeps the dome's opening positioned above the telescope as it tracks the stars westward. When he started working at Allegheny in the late 1970s, observers worked alone but kept so busy that they didn't have time to get lonely. "There was kind of a heroic element when one person did practically everything," says Kirby. A self-described house husband, he relishes the chance "to be involved in astronomy on a professional level."

Despite the increasing automation of the telescope, the floor man must still pinpoint each target star by hand. Lying on his back underneath the telescope, Kirby holds a heavy, old-fashioned eyepiece about the size of a softball and tries to focus on an exceedingly dim group of stars so that he can center each star in its own hole in an aluminum platen. Then, just before the run begins, he puts a fiber optic probe into each hole. The probes are attached to photomultiplier tubes that will record photons of light arriving from each star.

Because Wagner is in the observatory's booth overlooking the floor, he can stay slightly warmer than Kirby. He oversees the computers that collect data and guide the uniquely sophisticated instrument. "There's no other place in the world where you can work with a telescope like this [one]," he says.

An archivist by day, Wagner says he likes telescopes "the way some people like cars."

The overseer of all this nighttime activity is the observatory's director, George Gatewood, a professor of astronomy at the University of Pittsburgh. He is one of only a handful of astronomers who have led a long-running search for planets outside the solar system ("extrasolar planets" in astronomers' parlance). His steady research is notable in one of astronomy's most volatile fields: every year it seems one or two scientists announce the discovery of new planets, but not one has survived further investigation.

> "Any time we thought we were special in the universe, we've been wrong."

Gatewood's pursuit of planets is quite a switch from the reputation he developed shortly after coming to Pittsburgh in 1970 to begin his doctorate. As part of his research, Gatewood disproved the existence of planets reported around nearby Barnard's star, and after he obtained his degree he ruled out a reputed planet around a star named Lalande 21185. Back then, Gatewood laughs, he was known as a "Klingon who wiped out planetary systems every year."

After these two investigative triumphs, Gatewood was asked if he'd ever thought of searching for planets instead of disproving their existence. The idea excited him greatly. "It would be extraordinary if we could say to humankind that over there by that star is a little blue planet just like Earth," he says today. "That's sort of the carrot that you would hang in front of the next generation and say 'Do you think you can get there?' "

Unfortunately, finding planets around other stars is not a simple matter of pointing a telescope and observing them directly. That would be like trying to see the glow of a firefly hovering next to a searchlight. "To an observer 33 light-years from the solar system looking back at it," says David Black, director of the Lunar and Planetary Institute in Houston. "Jupiter is one billionth as bright as the sun and very close to it—just one half-second of arc away." That's roughly the width of a dime viewed from a distance of four miles.

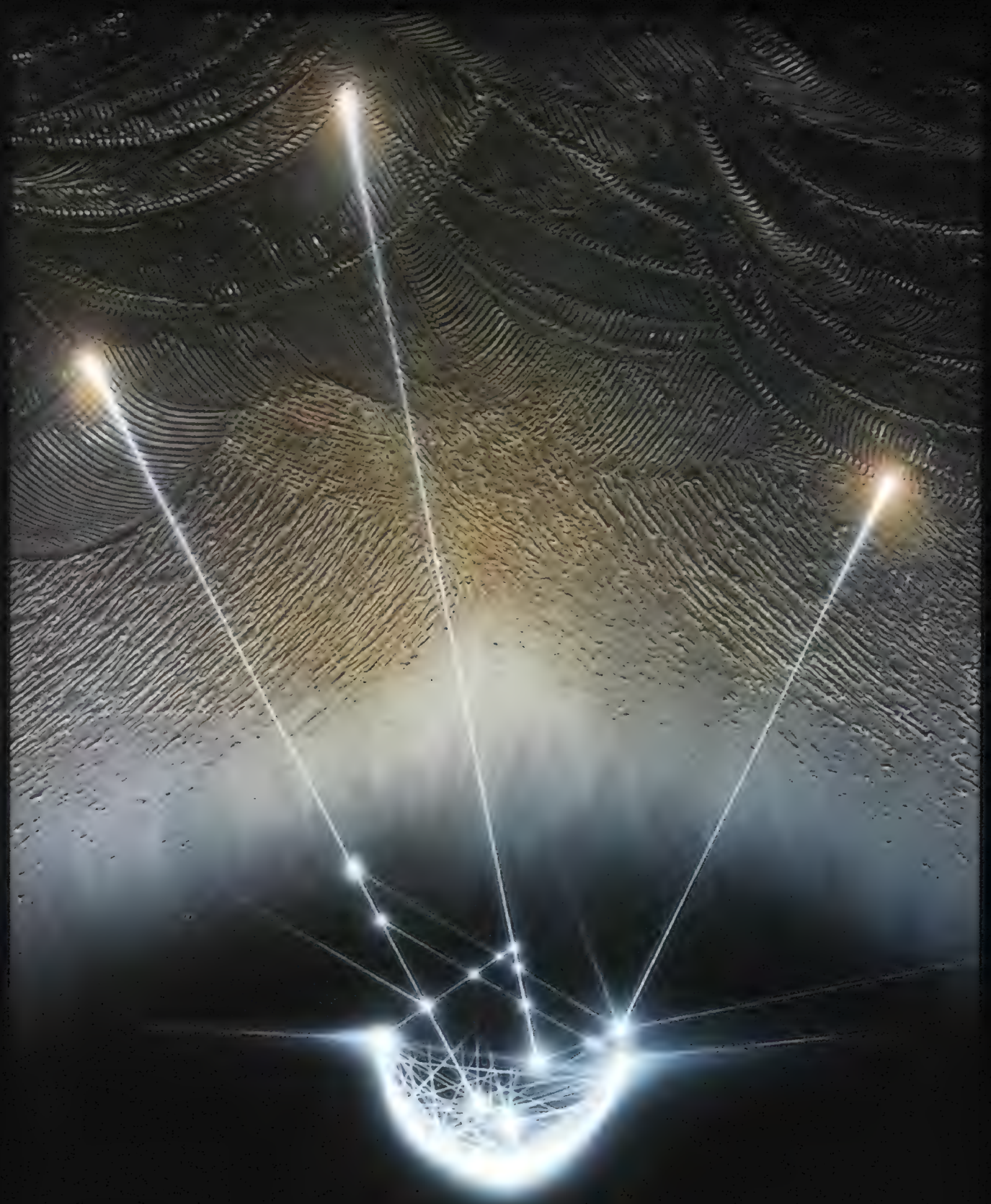
Astronomers hope to get around this difficulty by using indirect methods of observation. The search at Allegheny employs a technique called astrometry, which measures the position of a star with respect to a field of far more distant stars. All stars are moving, but the field stars are so distant they appear immobile, while the nearby star has an apparent movement known as "proper motion." Observations repeated over many years show the change in the target star's position relative to the field stars.

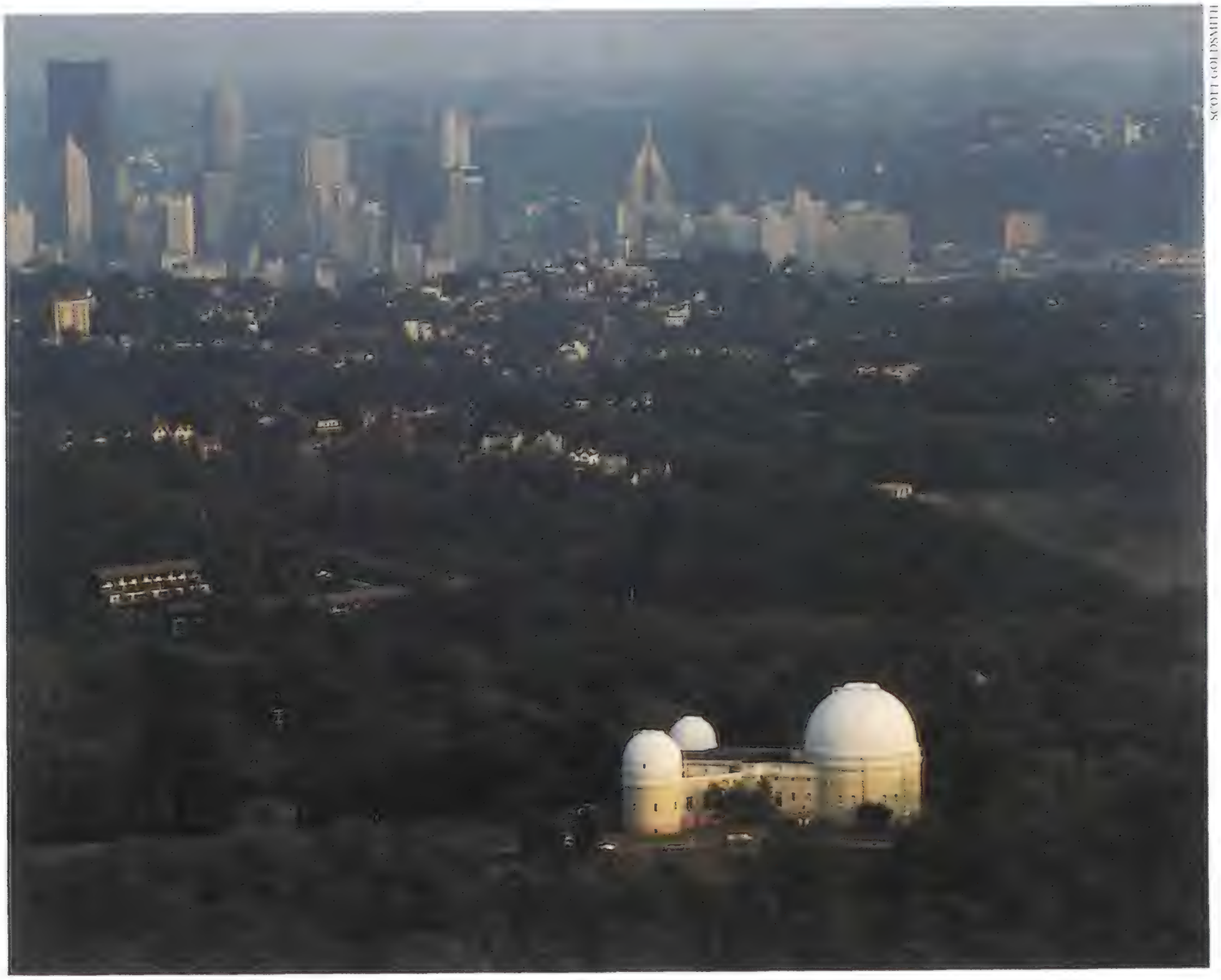
Until the mid-1980s, Gatewood used photographic plates taken over a period of years to capture the positions of a target star against background stars. The technique has been updated—the photographic film was replaced with a photoelectric detector—but the principle is the same. Each observing run of about 42 minutes through one region is equivalent, says Gatewood, to "one frame of a long movie."

If a star has no companions in orbit around it, its proper motion will be a straight line. But one or more companions revolving around the star will interact with it gravitationally. The resulting wobble in the star's track may be detectable. "It's like watching a polka dancer with an invisible partner," Gatewood says. "You can know about the invisible partner because of the loops the visible partner makes."

The polka that Gatewood is watching, however, is exceedingly slow. A planet the size of Jupiter could easily have a 10- or 20-year orbital period, and Gatewood wants to observe an entire orbit. "This is not a science for the impatient," he says.

Even though deviation from straight-line motion might be detectable in a few months or years, "you can convince yourself pretty quickly that it could have been a statistical fluke," says Gatewood. The history of the field—planet discoveries followed by disproof and retraction—and his own role in it have made Gatewood more careful. "You could very well delude yourself into spending a lifetime chasing down something that isn't there," he says. "There have been a few oc-





SCOTT GOLDSMITH

The Allegheny Observatory has an impressive view of the Pittsburgh skyline, but at night the city's bright lights become a nuisance for observers.

casions when I thought I saw something exciting in the data. I forced myself to spend another season looking at it before I published, and I've been glad I have."

Though Gatewood has not yet identified any planets, he says he is not disappointed. "It's also exciting that you may not find any planetary systems," he says. "It's quite possible that our solar system and our little blue planet is unique. That would be a heck of a piece of information."

With little in the way of positive results to report so far, astronomers still think, for theoretical, observational, and even philosophical reasons, that extrasolar planets exist. Since astronomers see numerous patterns in the universe, it's hard to believe that our solar system is a one-of-a-kind occurrence. "We don't see very many unique astronomical objects," says Robert Stefanik, director of the Oak Ridge Observatory in Harvard, Massachusetts.

David Black says studies of the solar system have enabled astronomers to develop a paradigm for how planetary systems form. The planets in our solar system are thought to

Name That Companion

If astronomers do detect a companion around a star, how will they know what it is? Theoretically, it could be a planet, another star, or something in between.

Planets form, scientists believe, out of the dust and gas ringing young stars, a "bottom up" process called accretion. As dust grains collide, they stick together, ultimately building up a rocky planet. In the case of Uranus and Neptune, they formed far enough from the hot sun for ice to condense on top of a rocky core.

Star formation, on the other hand, is thought to be a "top down" process. The cosmic nurseries for stars are slowly spinning gas clouds tens or hundreds of light-years across. The clouds collapse under the force of gravity. If the collapsing cloud has the mass of 80 or more Jupiters, the pressure at its center should be sufficient to start fusion of the hydrogen fuel, and a star is born. Sometimes the collapsing cloud spins so fast that it fragments into two smaller clouds. In this case, some of the spin, called angular momentum, is transferred to orbital motion and a two-star system forms, each star orbiting the common center of mass. Most stars, in fact, belong to multiple-star systems.

Astronomers believe that objects less than 80 Jupiters in mass may form the same way, yet lack sufficient mass to ignite. Such objects, which have never been conclusively detected, are called brown dwarfs.

The boundary between a planet and a brown dwarf is unclear, but some astronomers put the lower limit of the mass of a brown dwarf at about 20 Jupiters. No object between one and 80 Jupiters has been confirmed, though in 1984 Donald McCarthy of the University of Arizona thought he had found an object the size of 50 Jupiters orbiting around a nearby star named Van Biesbroeck 8. Unfortunately, independent searches conducted over the next few years found no trace of the much publicized object. McCarthy, who uses infrared imaging to look directly at stars and their faint orbiting companions, says: "We were burned by nature. You have to correct for the [Earth's] atmosphere in a detailed way and we seem not to have done it right."

As astronomers such as McCarthy improve their ability to detect very dim objects, the gap between planets and stars may be closed. Or the gap may be real: the processes that give birth to planets and stars may not overlap, making brown dwarfs rare or nonexistent.

Astronomers expect planets to be small, not much larger than a few Jupiters. They expect them to have roughly circular orbits—the net effect of numerous collisions during the accretion process. And they expect planets to occur in sets, not singly.

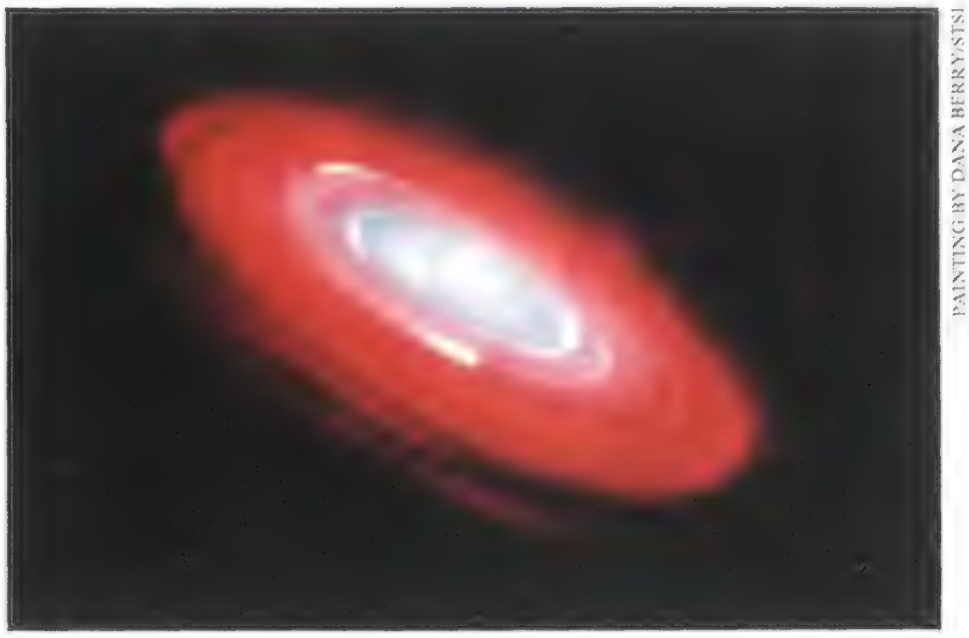
Brown dwarfs or dim stars orbiting visible stars will be much larger. They're likely to have eccentric orbits, reflecting the violent gravitational collapse that created them. And they'll probably occur singly, since the spinning cloud of gas that precedes a star is more likely to split into two rather than many bodies, yielding a parent star and only one companion.

have grown from a disk of dust and gas that circled the early sun. Astronomers have observed many young stars surrounded by such disks. Our sun appears to be a "fairly pedestrian star," says Black. "It sits in the celestial boondocks of our galaxy, well out in the suburbs. There is nothing astronomically special about this star."

Says Bill Cochran, a planet searcher at the University of Texas: "Any time we thought we were special in the universe, we've been wrong."

While other Earths may be lurking around sun-like stars, they won't be discovered any time soon. A planet the size of Earth has such a small gravitational effect on its parent star

Astronomers speculate that planets may be forming in the disk of gas and dust around the star Beta Pictoris.



PAINTING BY DANA BERRY/STSI

that current Earthbound telescopes couldn't possibly detect its presence. Most of the half-dozen or so serious planet searches, however, have the capability of detecting a planet the size of Jupiter, which is 318 times the mass of Earth.

David Latham, an astronomer at the Harvard-Smithsonian Center for Astrophysics who seeks planets and other companions around stars, says a Jupiter-size planet may indicate the presence of smaller planets around the same star. He describes computer models by other researchers that simulate how material from the disk around a star clumps together to form a planet. Researchers "inevitably get the little planets in the inner part of the system they're modeling if they get the

big ones in the outer part," he says. "That's not a proof, but it gives me some confidence that people will not object too strongly to the idea that if you find the big ones you're getting the smoking gun" for other planets as well.

While George Gatewood must contend with the urban light pollution and cloudy skies that come with his northeastern location, at least he has what he calls the "unsung heroes" of the planet search, the enthusiastic and talented amateur observers. On the other side of the continent, at Arizona's Kitt Peak, Bob McMillan has much better observing conditions. But the University of Arizona astronomer leads a planet search and shares all of the observing with just one other astronomer.

"I have to tell you," he says, "when you put in four to six nights at the observatory a month, it's a big chunk of your life. It takes a couple of days to get ready and then a couple of days to get back in the swing of things. That's about half the calendar gone each month."

For McMillan, the acclaim that would accompany a planetary detection seems a small part of his motivation to continue. "My personal goal," he says, "is to do new things with instrumentation. I derive my satisfaction from seeing the equipment work, whether or not there are planets out there."

But when pressed on why he stays in such a grueling field, he says, "Well sure, I think that it's one of the more profound things to be working on. Because it's a clue toward answering the question of whether there is another place like this. That obviously has a great popular attraction and I don't

SCOTT GOLDSMITH

George Gatewood uses Allegheny Observatory's 30-inch Thaw refractor in his pursuit of planets.

think astronomers are that much different from any other people. It would be pretty neat to find out something like that."

STANLEY GEORGE

McMillan, like Gatewood, is trying to detect changes in the motion of a star that result from the gravitational pull of one or more companions. But instead of trying to detect a wobble in a star's proper motion, McMillan is trying to detect changes in a star's radial velocity—its movement toward or away from an observer. He uses a 36-inch telescope at the University of Arizona's Steward Observatory to gather starlight, which is transmitted by an 89-foot optical fiber to a spectrometer on the building's ground floor. There the light is analyzed by wavelength. If a star moves in a straight line at a constant speed, its spectrum won't change from measurement to measurement. But a companion orbiting the star will tug the star back and forth, causing the spectrum to be Doppler-shifted: the light waves will become shortened—blue-shifted as the star moves toward Earth and stretched out—red-shifted—as the star moves away.

The effect will be very small. And, as with astrometry, it may take a long time to reveal itself. As planet searchers are prone to do, McMillan chooses Jupiter for his analogy. Alien astronomers looking at our solar system, he says, would see that the giant planet changes the sun's radial velocity by about 39 feet per second, just about the top speed achieved in the 100-meter dash. Furthermore, it would take 12 years—Jupiter's orbital period—to see the full effect.

McMillan is not alone in the spectroscopic search for planets. Both Harvard's David Latham and the University of Texas' Bill Cochran, as well as a few other astronomers, have projects based on the same principle. The difficulty all of them face is maintaining accurate and repeatable measurements for 10 to 15 years. "One of the goals for long-term observing is to make the instrument as simple and reliable as possible," says McMillan. "You need to concentrate on exhaustive tests, verifications, calibrations, and so on, much more than in the average observing program."

His seven years of observing 16 solar-type stars have been "pretty wearing," McMillan admits. And although he has published discoveries about other stars, he does not yet have results from the planet search. But he's not apologetic. "Given the history of announcements of planet detections, one has to be extremely conservative," he says. "If it's real, it will stay real."

Every planet hunter needs McMillan's patience. Says Gatewood: "There's a Columbus effect going on here. You know, each person wants to be the first one to discover a new world." One astronomer may have discovered a new world without even looking for one.

Aleksander Wolszczan, now on the faculty at Pennsylvania State University, got lucky in January 1990, when the 1,000-foot radio telescope at Arecibo, Puerto Rico, was undergoing repairs. For two months the telescope was unable to track astronomical targets. It could only be used as a transit telescope—pointed up to observe the sky drift by as the Earth rotated.

ROGER H. RESSMEYER/STARLIGHT

Was Wolszczan disappointed? Quite the contrary. "I was very happy," he says with a grin. "It was the only way to do what I wanted."

Wolszczan studies pulsars, rapidly

Planet hunter Bill Cochran (above) looks for Doppler shifts in a star's visible light, which could be evidence of an orbiting companion. His colleague, Donald McCarthy (right), hopes to find planets by detecting their faint infrared signatures.

spinning neutron stars about 12 miles across but nearly 50 percent more massive than the sun. These small but incredibly dense bodies form from the remains of stars that have undergone violent supernova explosions. As pulsars quickly rotate, about once or twice a second, they sweep their strong radio beams through space like lighthouse beacons, creating a pulsing effect observable on Earth. Pulsar rotation is so precise it can be used to time other astronomical phenomena.

Though most pulsars have been detected close to the plane of the Milky Way, Wolszczan wanted to look elsewhere. Had the Arecibo antenna been working as usual, it's doubtful that his chancy search would have been approved. But Wolszczan's gamble paid off: he found two pulsars spinning hundreds of times a second, so fast that their period of rotation is measured in milliseconds. They are only the fifth and sixth millisecond pulsars ever found away from the galactic plane.

> **"There's a Columbus effect going on here. Each person wants to be the first to discover a new world."**

One of the new discoveries turned out to be a so-called relativistic binary, a pulsar and another neutron star orbiting around a common center of mass. At the time, Wolszczan says, he thought of his other discovery as just "a vanilla-flavor millisecond pulsar."

How wrong he was. As he continued to observe that pulsar, he noticed that it "misbehaved." Some pulses arrived a few thousandths of a second sooner than expected and others arrived a few thousandths of a second later. Millisecond pulsars are so precise that one can usually specify within microseconds when a particular pulse, say the 1,206,439,445th, will arrive.

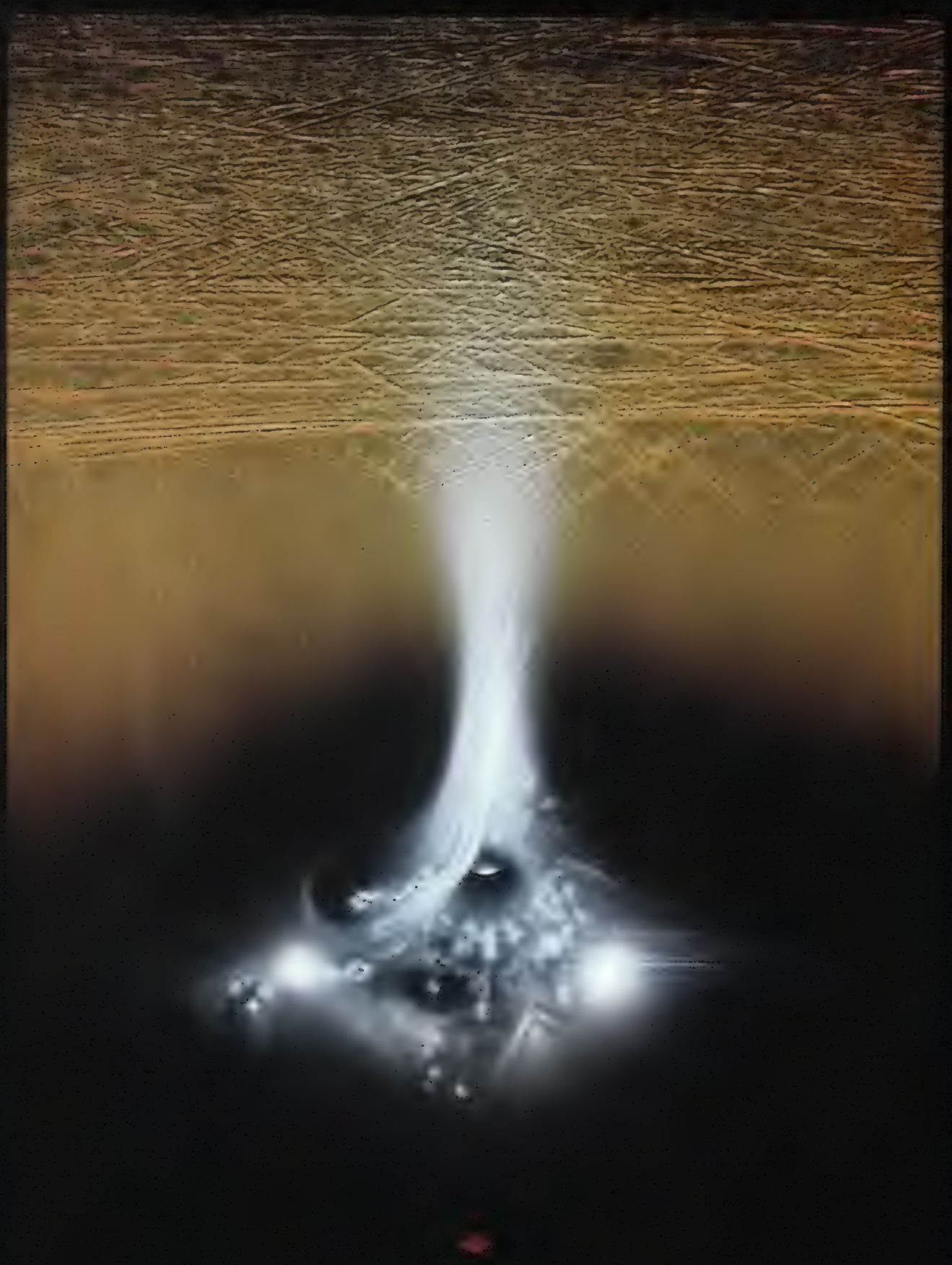
To explain this queer behavior, Wolszczan speculated that something was tugging the pulsar, first a little bit away from Earth, then a little bit toward it, Doppler-shifting the pulses. The model that best matches the arrival times of the pulses, says Wolszczan, has two planets somewhat larger than Earth orbiting the pulsar every 67 and 98 days. (The great accuracy of pulsar timing permits the detection of companions much smaller than is possible with the techniques used for conventional stars.)

Wolszczan made his announcement just as another pulsar planet discovery was being retracted. The University of Manchester's Andrew Lyne, who had announced a planet six months before Wolszczan, found a mistake in his analysis and quickly owned up to it. But Lyne's retraction hasn't squelched excitement about Wolszczan's observations, since they are not subject to the same problems as Lyne's. Still, given the dismal track record of planet discoveries, caution is the watchword. To conclusively test his results, Wolszczan must collect data over the next five years. Models of the possible planets' motions predict that they should interact gravitationally in a way that would alter the arrival times of the pulses. Wolszczan must keep timing the pulsar and look for the arrival times to change as calculated.

Wolszczan's pulsar planets—should they withstand scrutiny—are important, says Latham, because "they give us confidence that planets don't have a whole lot of trouble forming if they can do it out of the debris of a supernova explosion or the disintegration of a companion star to the neutron star." Researchers won't be satisfied, however, until they find evidence that planetary systems around ordinary stars are abundant. And if they don't? Eugene Levy, director of the University of Arizona's Lunar and Planetary Laboratory, puts it this way: "If a high-sensitivity search of 100 nearby stars doesn't turn up planetary systems in a decade, it undermines everything we think we believe about how planetary systems form."

And so the hunt continues, with no one showing any signs of throwing in the towel. "If we didn't have some pretty strong suspicion that there might be others," says Latham, "we probably wouldn't be investing so much effort in looking for them."

ART BY ANDREAS NOTTEBOHM



The High Cost of Secrecy

Steven Aftergood, director of the Project on Government Secrecy, and John E. Pike, director of the Space Policy Project, Federation of American Scientists

Today, seemingly credible reports suggest the existence of a new generation of classified aircraft. Numerous eyewitness accounts and even videotape footage indicate that one or more types of stealthy or hypersonic surveillance airplanes—successors, perhaps, to the recently retired SR-71 Blackbird—may be undergoing flight tests over the California desert.

There are cases to be made both for and against the development of such aircraft. They could bring unique advantages to the reconnaissance arena by providing continuous coverage of a battlefield, where satellites offer only brief snapshots. And hypersonic aircraft could provide imagery of a crisis area as rapidly as do satellites but with greater flexibility. However, a stealth reconnaissance airplane probably wouldn't match a satellite's speed in delivering information, and a hypersonic aircraft, unable to loiter, could not provide the long-term coverage a satellite can.

There is no legitimate reason why questions about the need for these new aircraft cannot be debated in public. The new programs' mission requirements, priority among competing needs, and costs are all proper subjects for public consideration. Yet these programs are kept hidden from public scrutiny.

Secrecy in military aerospace has exceeded all reasonable justifications.

Programs whose cost, purpose, and very existence are withheld from the public are known as "black" programs: they've included the development of cruise missiles and stealth technology, propulsion research, and other types of weapons systems and components. The biggest and best known of these, however, are the aircraft programs.

Over the last several decades, many of the nation's most advanced military aircraft have been developed in secrecy. From the U-2 spy plane to the B-2 bomber and beyond, critical programmatic and funding decisions have been made beyond the sphere of public awareness and debate.

As the history of these black aircraft programs has come to light, it has become possible to achieve a new perspective on the advantages and disadvantages of secrecy in this field. While classified aircraft programs have yielded some of the most remarkable technological achievements of our time, the secrecy surrounding them has become both ineffective over the long term and counterproductive.

The mystique of the Lockheed Skunkworks, for example, is based on a public perception of an unbroken string of successes, including, notably, the U-2 and the SR-71. What is much less well known is that in the 1950s these successes were punctuated by a notably unsuccessful effort, the CL-400 Suntan. The Suntan, intended to surpass the U-2 in high-altitude, long-range reconnaissance, consumed over $1 billion (in 1992 dollars) before engineers concluded that it could not meet its mission requirements and the program was canceled.

More recently, excessive secrecy was identified as an important cause of the collapse of the Navy's A-12 attack aircraft program. The House Armed Services Committee reported in 1991 that "special access restrictions on the A-12 program and the lack of appropriately cleared auditors...prevented the program from receiving adequate management control and oversight," leading to its cancellation that year. The resulting loss to the taxpayers was in the billion-dollar range.

Secrecy in military aerospace, as throughout government generally, has exceeded all reasonable justifications. No one would dispute that advanced military technologies require some degree of protection. But it is clear that the secrecy surrounding classified aircraft programs has reached the point of absurdity. According to an *Air Power Journal* report, F-117A stealth fighters were not called upon in the 1986 air strike on Libya because using them in the raid would have made denial of their existence more difficult.

In matters of science and technology, secrecy is at best of limited effectiveness and is more often an obstacle to development. In the best of circumstances, secrecy can offer some lead time over competitors or

It's time to cast some light on the military's "black" programs.

adversaries who, sooner or later, are bound to duplicate or independently achieve the desired goal.

But even such lead time may be far more limited than is commonly assumed. A task force from the Defense Science Board, an independent body that advises the Department of Defense, reported in 1970: "Never in the past has it been possible to keep secret the truly important discoveries, such as the discovery that an atomic bomb can be made to work or that hypersonic flight is possible.... In spite of very elaborate and costly measures taken independently by the U.S. and the U.S.S.R. to preserve technical secrecy, neither the United Kingdom nor China was long delayed in developing hydrogen weapons."

More importantly, secrecy tends to obstruct technological development by inhibiting communication of useful information, undermining peer review, increasing costs, generating public mistrust, and, all too often, promoting fraud and abuse. Excellence in science and technology does not always correlate with professional credentials, much less with security clearances.

Excessive secrecy also renders some of the nation's most talented engineers economically sterile, as it insulates their product from the marketplace. At a time when economic security is more at risk than military security, government restrictions on dissemination of technical information are mounting. A reversal of this trend might have important economic benefits, since some black program achievements may have useful commercial applications, particularly in the fields of propulsion, remote sensing, and materials science.

Finally, the cost of keeping secrets is becoming intolerable. According to a defense department estimate, the bureaucracy of government secrecy has exploded to the point that the cost of protecting classified information in industry reached a stunning $13.8 billion in 1989 alone.

Classification extends so far beyond the genuinely sensitive details of advanced military technologies that one might conclude it is being used to protect controversial programs more from public awareness than from hostile intelligence services. For years, the Pentagon refused to disclose projected costs of the B-2 bomber program, claiming that to do so "would provide information which might be of assistance to the Soviets." At the same time, some Pentagon officials privately acknowledged that such cost information would be of little use to the Soviet Union. And of course it would be of even less use to technologically lagging nations such as Libya, Iraq, or North Korea.

Yet approximately 15 percent of the defense department budget for weapons acquisition is classified. The way this money is spent is withheld not only from the public but even from the overwhelming majority of members of Congress. The "special access" classification system imposes restrictions on information that go above and beyond the "need to know" requirements of the ordinary classification system.

It's worth emphasizing that oversight of aerospace programs does not necessitate disclosure of all technical details, many of which are likely to be properly classified. But special access restrictions undermine the most minimal level of independent oversight and accountability, as in the case of the A-12 program.

In fact, it appears that black aircraft programs are designed only to penetrate Congressional airspace. That is, wasteful, dangerous, or highly speculative programs will have a much better chance of being funded by Congress if they are highly classified.

While some military programs of the past were justifiably hidden from public view—most notably the Manhattan Project, which developed the atomic bomb—the diminished strategic threat to the United States and increasing budget pressures now dictate a new attitude of increased openness and accountability in the hyper-classified field of military aerospace. In a democracy, after all, the public has the ultimate need to know.

It appears that black aircraft programs are designed only to penetrate Congressional airspace.

THE BATTLE OVER THE RIM

Are air tour operators spoiling the Grand Canyon?

by David Savold

Photographs by Bruce McAllister

A Bell LongRanger helicopter is skimming 500 feet above the Coconino Plateau and one of the largest ponderosa pine forests in the world. The pilot, Chuck Rush, is delivering a spiel over his headset to his four passengers, who have paid $70 each for this half-hour ride. The buttes over there, Rush tells his customers, are named Mencius Temple and Confucius Temple—suitably majestic names for the towering structures.

To underscore the magnificence of the sights, Rush has been playing a tape of the *Chariots of Fire* theme song over his passengers' headsets ever since taking off. But down on the trails, the sights and sounds can be far less transporting. Ed Norton, president of the Grand Canyon Trust preservation group, says that during a trip last year, "I hiked out the Hermit Trail, which is really very close to one of the [flight] corridors, and it's like being at the end of the runway at Newark. It's just constant, constant aircraft." In previous years, helicopters have flown so low they've forced hikers to duck to avoid being hit by the skids. "I had reports from [passengers] of moisture coming off the Colorado River—rotor wash, droplets of water

With its four-blade turboprops, the Vistaliner, a modified Twin Otter, produces less noise than most of the other airplanes flying over the canyon.


GRAND CANYON AIRLINES
Vista-Liner
AIRLINES

Though his job requires him to patrol the canyon by air, park service pilot Mike Ebersole understands the environmentalists' objections to aircraft noise.

on the windshield—because they were that low," says Mike Ebersole, a National Park Service pilot who patrols the canyon.

Over the years all kinds of pilots have indulged in aerial sightseeing excursions in the Grand Canyon, from military aviators taking joyrides to airline pilots straying from their routes. The temptation to check out the view from an aircraft is understandable. The Arizona canyon, which spans 277 miles in length and up to 18 miles in width, is a study in geological drama, filled with buttes, spires, amphitheaters, and other immense and awesome formations. One Englishman who visited the canyon, Alfred Noyes, captured the prehistoric grandeur of the place in a poem, recalling that "gigantic walls of rock,/Sheer as the world's end, seemed to float in air...."

Equally understandable is the temptation to set up shop flying tourists past these wondrous sights. With the exception of war years, visitation to the Grand Canyon has risen steadily since records were first kept. Aerial tours began operating regularly in 1927, though the industry didn't really take off until 1965, when Grand Canyon National Park Airport was built near the park entrance. These days, some 40 companies offer air tours. While no one keeps track of the total number of flights made over the canyon, each year the Grand Canyon airport sets records for aircraft operations; last year the tower chief reported that during a single hour there were 132 takeoffs and landings.

And for environmentalists like Ed Norton, it's all too much.

The debate over the presence of aircraft in the Grand Canyon is based in part on the quality of the quiet there—a quiet so deep the human ear isn't sensitive enough to appreciate it fully. Steve Hodapp, who spent five years as chief of resource management at Grand Canyon National Park and now works on the House subcommittee on national parks and public lands, likes to say: "You can't hear how quiet it is at Grand Canyon."

"We're discovering that natural quiet is a resource," says Mike Ebersole. "It's an intangible resource, but it's something that park managers are having to realize they're going to have to manage for natural quiet. And I know it's not like a squirrel or a pine tree or something you can put your hands on, but we have to manage for the resource."

A 1985 trip to the canyon was enough to convince then-Congressman John McCain of Arizona. Having planned to take a rafting trip, McCain headed down the seven-mile South Kaibab Trail, which zigzags from the canyon's rim to the Colorado River at the canyon's bottom. But as he made his way down the path, he grew increasingly annoyed as he found himself "virtually never free of the incessant drone of aircraft." When he returned to Washington, the Congressman testified before the Federal Aviation Administration about the racket, and he joined in a legislative effort to limit flying over the canyon.

The following year a Bell 206 helicopter flying near Crystal Rapids in the canyon collided with a DH-6 Twin Otter airplane, killing 25 people. It was one of the worst air accidents ever to occur in the canyon. Suddenly the issue was no longer simply peace and quiet but safety as well. Congress and the Senate quickly passed the pending legislation, which President Reagan signed into law as the National Park Overflights Act of 1987. The act called for a study to determine minimum altitudes for aircraft flying over national parks. In addition, it ordered the National Park Service to set up an aircraft management plan for the Grand Canyon that would provide a "substantial restoration of the natural quiet and experience of the park." In the fall of 1988, the park service, with technical assistance from the FAA, established minimum altitude requirements and four flight-free zones encompassing 530,000 acres—44 percent of the park. Between them are corridors, ranging from two to nine miles in width, for air tour operators.

"I think the current legislation is desperate overkill," says Dan Lawler, president of Air Grand Canyon. He's sitting in a booth at Nancy's Skyway Restaurant, a pilot hangout at the Prescott, Arizona airport, about two hours south of the Grand Canyon. On a napkin Lawler draws the flight-free zones. "The loss of that portion of the canyon," he says as he points to a zone called Shinumo, "was in my opinion quite a blow." In Shinumo, Lawler liked to fly below the canyon's rim, raise the wing, and let his passengers look up at the canyon wall. "Then they could say they had flown in the canyon," he says. "We knew it was way off...and nobody was down there and we weren't bothering anybody."

Lawler points out that "the reason the industry is growing is that the public, largely the tax-paying American pub-

Air tour passengers enjoy stopping over at the Havasupai Indians' village (right), which features gorgeous waterfalls (left). But the residents find all the overhead noise wearing.

Helicopter tour operator Miles Becker argues that visitors have the right to tour the canyon any way they choose, whether by hiking or by flying.

lic, wants this service." He talks of flying tours so stunning that "grown men would get off my airplane with tears running down their cheeks." And he observes that the number of backcountry hikers amounts to only a tiny fraction of the number of visitors who tour by air. Last year, for example, a total of 13,100 applied for hiking permits, while half a million embarked on air tours out of Grand Canyon National Park Airport alone. The way Lawler sees it, the objections to airplanes in the canyon are just the complaints of "a small number of hikers and wilderness-seeking people [who] were bothered by the sound that the aircraft make."

To get a better fix on the magnitude of these complaints, the park service has taken a number of steps. In the mid-1980s it organized a series of public meetings on the issue, which provided a forum for a variety of interested parties, from a former Vietnam helicopter pilot vehemently defending his livelihood to environmentalists who wanted to ban aircraft from the entire canyon. "We had people at the public meetings angry about contrails, angry about the space shuttle—they didn't want *anything* going over the Grand Canyon," says park service pilot Mike Ebersole. At perhaps the most memorable meeting, members of the Earth First! environmental group, dressed as bighorn sheep, crows, and raccoons, jumped on stage with the western regional director of the park service and showered him with phony dollar bills. "Their point was that we were in bed with the tour operators—we could be bought," says Ebersole.

Last year, in accordance with its Congressional mandate, the park service distributed a trial questionnaire to people visiting the park asking how the aircraft affected their experience of the canyon. But the tour operators complained that the survey was biased with leading questions, and they found some independent experts to back them up. To its credit, the park service incorporated some of the tour operators' suggested revisions in the final version of the questionnaire, which is being distributed this year.

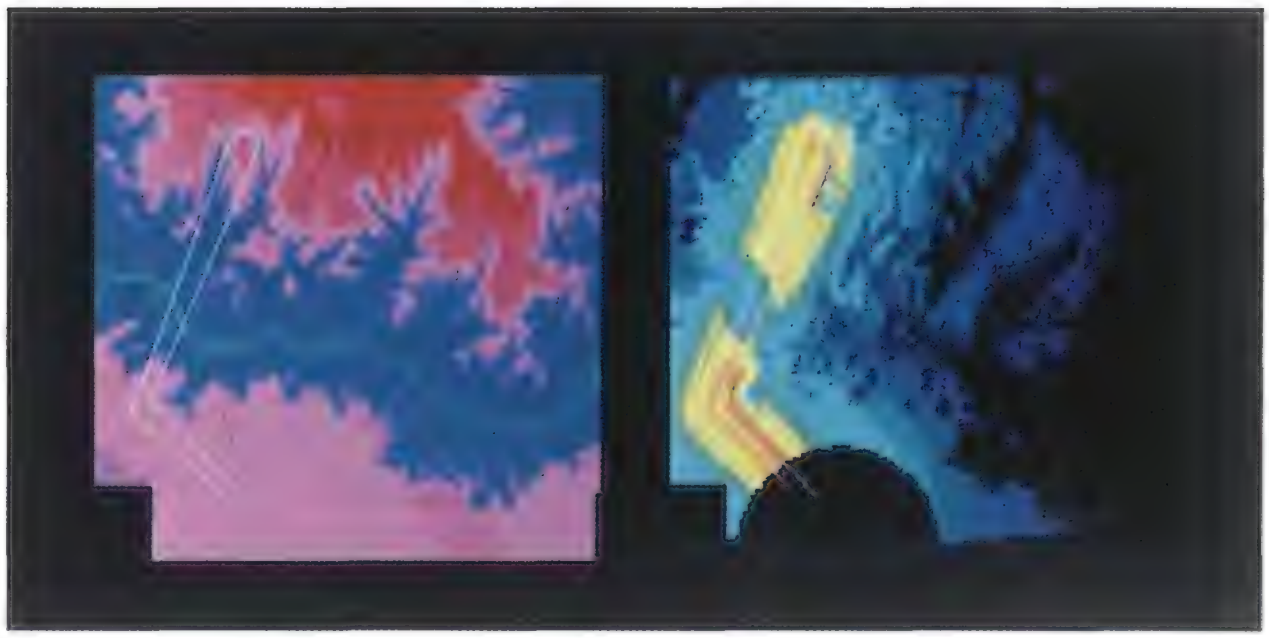
Lawler's dismissal to the contrary, it's not just environmentalists who complain. The Havasupai Indians, who have lived in the canyon for at least 700 years, also object to the noise of the aircraft. The word Havasupai means "people of the blue-green water," which refers to a spectacular series of waterfalls in the side canyon where the tribe lives. The waterfalls and the tribe itself are part of some air tours, and a helipad is situated in the middle of the Havasupai's residential area. In past years, flights over the village became so frequent that during peak seasons there was no time during the day when aircraft noise couldn't be heard. "It's a small community," says Don Watahomigie, chairman of the Havasupai. "We don't appreciate the aircraft. That's how we feel about the whole aircraft situation—other than emergencies."

According to Grand Canyon park archeologist Jan Balsom, the Havasupai's attitude toward the helicopters can shift with the political winds, with some tribal leaders being more tolerant of the tours than others. The tribe does make money from the tours; because it owns the helipad, it charges operators for landing privileges.

The aerial tour operations provide other benefits as well. When hikers and river runners are in distress, they will flash mirrors to signal tour pilots passing overhead, who will then relay the alert to the park service. And several river-trip operators rely on helicopters to transport passengers from the river back to their accommodations.

There's also evidence that some of the woes attributed to aircraft have been exaggerated. The news media play reports of air crashes at the Grand Canyon so prominently that the canyon comes across as a pagan deity requiring frequent sacrifices of planeloads of tourists.

The canyon is a popular vacation stop for Asian visitors. Some air tour operators advertise heavily overseas, hoping to corner part of the lucrative international tourist market.



BBN SYSTEMS AND TECHNOLOGIES

Computer imagery provides a profile of aircraft noise in one section of the canyon. The left image shows a round-trip helicopter track; the right, the audibility of a helicopter flight through the same area. Red represents the loudest areas, black depicts areas where the noise doesn't penetrate, and the other colors indicate areas with intermediate noise levels.

As cartoon character Calvin knows, an airplane ride through the Grand Canyon appeals to the adventurer in all of us (below).

In fact, according to safety inspector Robert L. Trout of the FAA's Las Vegas flight standards district office, which regulates Grand Canyon flights, of the 106 crashes that have occurred in the area since 1950, only three actually took place in the canyon. The rest, such as the collision that killed 10 last June, have occurred en route to or from the canyon. And Trout points out that even the accident figures for the en route traffic are low, compared with statistics for commuter operators and general aviation throughout the United States.

Then, too, more environmentally correct ways of touring the canyon have drawbacks of their own. One of these—mule rides—is second only to aircraft noise in the number of visitor complaints it draws. The problem has to do with 105-degree summer temperatures and the fact that the mules tend to urinate in the same place again and again, creating enormous pungent puddles that hikers have to skirt.

Whether the annoyance is mules or helicopters, the same question inevitably arises: Just who is the Grand Canyon for? Miles Becker is the director of operations of Papillon Grand Canyon Helicopters, which deploys 16 helicopters at the Grand Canyon, and in his opinion, "people...should have the right to see [the canyon] in the way they desire to see it, whether it be by hiking, rafting, flying, what have you. I think we all have to share. [The canyon] shouldn't be restricted to only one type of person." The way Ronald L. Warren of Grand Canyon Airlines sees it, "For some of the environmental community, for some Americans, they are looking for something that perhaps may no longer exist—a wilderness free of the 20th century."

Alan Stephen, president of Scenic Airlines, is a bit harsher in his assessment of the environmentalists' expectations. "You can't go to the Grand Canyon and expect a wilderness experience," he says bluntly, referring to the 4.2 million visitors who descended on the park last year, making some of the trailheads resemble Coney Island on a summer afternoon.

Stephen is sitting in his office overlooking McCarran International Airport in Las Vegas. Outside, corporate jets belonging to Caesar's Palace and the Mirage are parked on the runway. "Can we make the noise situation better?" he asks. "Yeah, and there are studies going on. But is the solution that's there now [the flight-free zones] the perfect solution? No. I think—and the environmentalists would disagree with me—I think we've overreacted."

Ron Warren tries to strike a more conciliatory note: "We don't consider environmentalists our enemies," he says. "We believe that we have different opinions about how to achieve the same goals. We want to give them a totally quiet, natural-quiet canyon. We just believe that we can do it through operational modifications and technology, rather than the abolition of all aircraft."

UNIVERSAL PRESS SYNDICATE

What Warren is referring to is a product his company and Scenic Airlines now offer: Vistaliners, which are de Havilland Twin Otters modified with oversized windows and four-blade propellers. Vistaliners are quieter than the other aircraft that fly the canyon—mostly single-engine Cessnas—and Warren believes the distinction merits special recognition. He feels the FAA should reward tour operators flying quieter airplanes by granting them better air routes, altitudes, or some other compensation. Grand Canyon Airlines has invested $5 million in quieter airplanes, says Warren, "and we're still treated the same as a fellow flying a Cessna 185 or a 206."

But some tour operators question Grand Canyon's motives in promoting its Vistaliners. One pilot, who asked not to be named, charges that the airline, with its "virtual monopoly" on the quieter craft, is simply courting the favor of the park service and the environmentalists—and in that way trying to drive its competition out of the canyon.

Other splits have erupted among the pilots who fly the canyon. The FAA makes private pilots fly in corridors that

Tour operator Ron Warren believes "quiet aircraft" technology can satisfy environmentalists' demands.

are higher and wider than those designated for tour operators, arguing that the tour operators are more experienced at negotiating the narrow corridors between the flight-free zones. But the private pilots consider this restriction a hardship; some general aviation aircraft can't operate at these altitudes, and those that can are often not equipped with the supplemental breathing oxygen the law requires them to carry at those heights.

Last February, experts hired by the National Park Service presented the preliminary results of a noise study they had started in fall of 1989. The study aims to collect data at the canyon and use that information in a computer model to determine an acoustic profile of the canyon. These early results are "open to interpretation," says Mike Ebersole, but they do show that aircraft noise is still detectable throughout most of the park, even in those areas under the flight-free zones. The final results of the study are due next fall.

"I've said from the very beginning that the plan now in effect was a good first step, but it's not adequate and it doesn't achieve the purpose of the bill and there are going to have to be additional regulatory measures," says Ed Norton. "...You've got two choices: You either ban all flights over the canyon, which I would be prepared to do, unless additional steps are taken. Or you try to put [in] additional regulatory measures, including a quiet-aircraft technology standard."

Regardless of the conclusion the park service study reaches about the Grand Canyon, a larger question will remain: What should be done about aircraft in all of our national parks? The park service has identified over a hundred national parks that have been affected in some way by aircraft overflights. Several ongoing surveys, aimed at park managers, air tour passengers, and other park visitors, are looking into this bigger issue. "I think it's an extremely difficult question when you think of it in a broader perspective," says House subcommittee staffer Steve Hodapp. "Are we going to have places in this country where people can go and not hear aircraft noise?"

Judging solely by tranquil images like this one, it's hard to imagine a helicopter could make much of a disturbance at all in the immense canyon.

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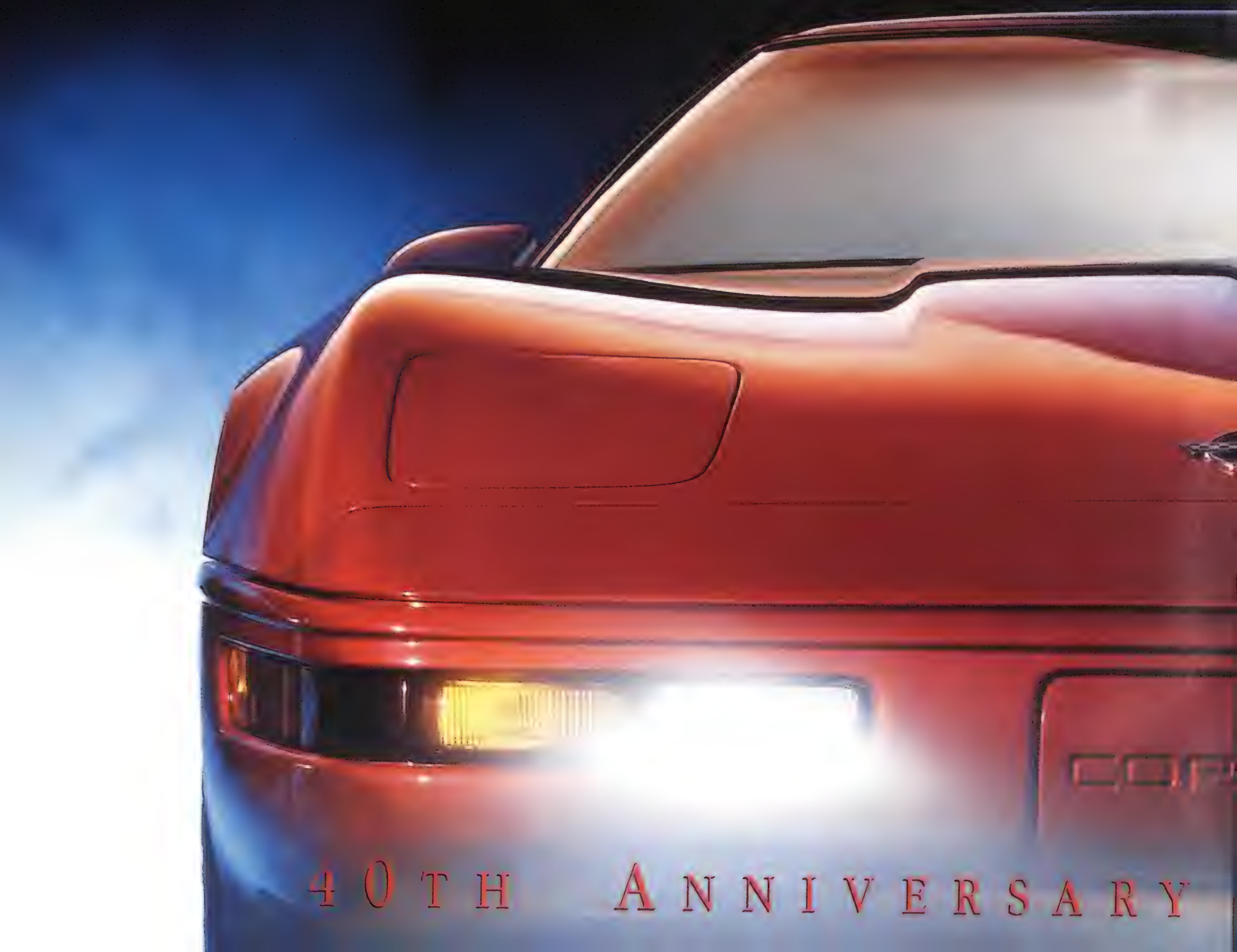

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LEAP OF FAITH

A Russian skydiving champion teaches an American novice that parachuting means more than adventure.

by Tom Harpole *Photographs by Irina Mikhailovna Kuznetsova*

To know a thing you have to trust what you know, and all that you know, and as far as you know in whatever direction your knowing drags you.

Sometimes a Great Notion,
Ken Kesey

Sergei Kiselov has spent a good part of his life outside earth's restraints. He devoted most of his 40 years in the Soviet army to weightlessness testing and instructing cosmonauts to skydive. He's spent over 70 hours, in half-minute installments, spread frog-like in unfettered falls, plunging more than 7,500 miles through the air. He seems to have elevated his psyche in the process. I am going to learn about skydiving from him.

On this February morning our idea is for me to make my first jump, but the weather looks bad. The sky, just growing light outside the dirty window of our two-cot room, threatens more snow.

My first exposure to skydiving was a video I watched with Irina Solovyova, a former cosmonaut. I had met her in San Francisco while I was working on a story about an Antarctic expedition she was mounting. Having learned that she was also a world champion skydiver, her hosts showed her a video of some California skydivers performing free-fall aerobatics.

After the video, Solovyova gestured toward the television and asked me, I thought, if I liked it. "*Da, da, da,*" I said emphatically, having been quite taken with the whole show. Months later, a painstakingly translated letter arrived from Moscow. It was a formal invitation from Solovyova and her husband, Sergei Kiselov, to skydive with them. In a year, I got myself to Moscow, and a few days later Kiselov got me to the Voloslova aerodrome, an army airfield

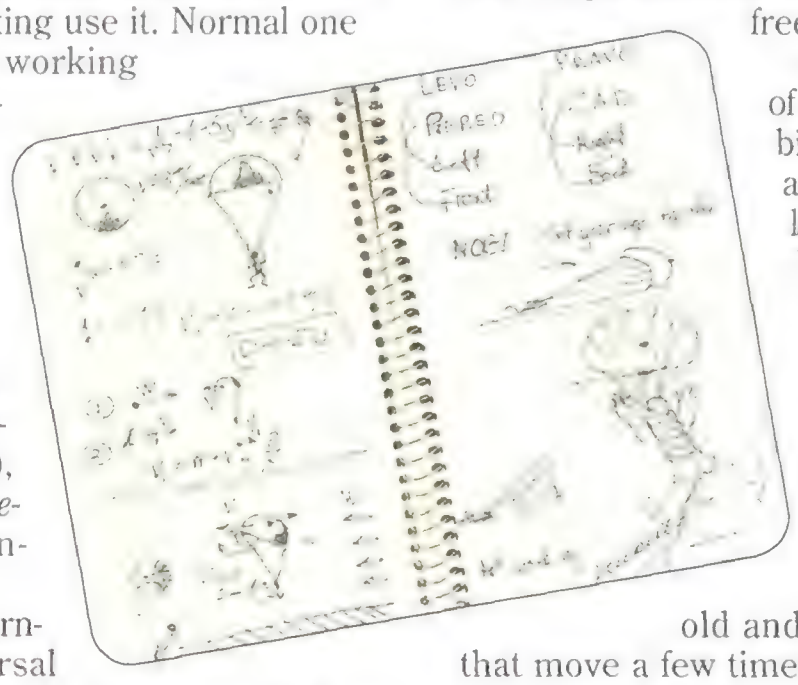
On an airfield south of Moscow, the author joins Russian paratroopers filing out to an Antonov An-2.

about an hour south of the city where young soldiers are trained to be paratroopers.

Kiselov, his index finger pointed skyward, roused me in his best English. "Life is life," he chuckled. He raised his finger higher and bestowed his only other English expression: "Yes o'clock." Undaunted by my ignorance of Russian, he began my ground schooling over breakfast. Half an eggshell served as a parachute canopy. He spoke slowly and distinctly as the eggshell repeatedly descended in his steady hand toward a table littered with cracked almonds, fish parts, and jerky. I assimilated two facts: "problem" means the same in both languages, and his repetition of the word "*nyet,*" while making dervish gestures overhead conveyed the message that bad things can happen even after the parachute opens. After just a few frustrating minutes, we knew we had a problem. We sat sipping tea, smiling and shrugging at each other, knowing my first jump would be an experience for both of us.

Mercifully, we were joined by a mutual friend who knew a little English and tried to translate Kiselov's instructions. I later played back the tape of one of these lessons and heard "Red strap working with apparat of high level. If big not working use it. Normal one but two will working at one hundred fifty meters." To allay the torturousness of the process, I would at times interject "*kahnyeshna*" (sure), or "*Ya pahneemyah*" (I understand).

The Antonov can get off the ground in about 700 feet with a full load of fuel and paratroopers (above). Kiselov reduced the essentials of skydiving to sketches and equations (below).



Kiselov, turning to universal languages, made two pages of drawings and equations in my notebook in an attempt to explain wind velocities, rates of descent, and parachute handling. While he drew a body being dragged across the ground, there was a loud knock at the door and a shouted announcement. The weather must have cleared. Kiselov thanked the voice, pointed at the 10 on my watch, and said, "Yes o'clock."

I pulled on the outfit Kiselov borrowed for me upon our arrival the night before: insulated overalls, tall sheepskin-lined boots favored by Russian skydivers, and a venerable leather aviator's jacket. We walked out into crusty snow and temperatures a few degrees below freezing.

On the other side of a thicket of young birches and pines, a wingless fuselage lay in the snow like a huge broken toy. We climbed in through a four-foot-wide door on the left side. Kiselov showed me how to place my left foot on the threshold and had me repeat that move a few times. Then he bent slightly, arms folded as though gut shot, and jumped out. He motioned for me to bend and jump on the same spot. When I did he said, "*Horosho*" (good).

We walked to a large swing set with dozens of parachute harnesses hanging from it. He showed me all the clasps and buckles and I shrugged one on. He dangled in the harness next to me showing me how to manipulate the four straps (two on each side, one fore and one aft) to make myself twist in the rig. This I understood. Harnesses, whether for alpinists or draft horses, make a sense of their own when the webbing and hardware are hooked up. This harness, with a few adaptations for high winds and the sudden load experienced when the parachute opens, looked respectably over-engineered.

Then several unmuffled motors fired up. We walked through a fringe of forest and out into the vast jump zone, where the prop wash from four big biplanes blew up a small blizzard on the airstrip.

At the staging area about 50 paratroopers milled around the piles of packed chutes stacked on crisp canvas ground cloths. Some of the soldiers, already strapped into their chutes, sat smoking on benches that faced the airstrip. A civilian instructor approached me with a parachute and reserve chute and silently buckled me in.

When we were ready Kiselov reminded me that his wife, the ex-cosmonaut who was responsible for my trip, had advised me to speak into my tape recorder during our ascent. Cosmonauts are required to jump as part of their psychological training. On the ride up for their first jump, she explained, they are told to recite poetry, do simple math, or just record their feelings. Many can't utter a word. I made sure the recorder was accessible, in a pocket above my knee. Kiselov headed toward the idling Antonov; I followed like an acolyte. A column of army paratroopers filed along behind us. The last

150 feet to the airplane Kiselov began jogging, silver hair streaming from under his stocking cap. Jogging with 40-pound parachutes on seemed excessive until I realized that the proper pace for approaching an airplane you have decided to jump from is at a run.

The Antonov An-2 biplane has been unrivaled since the late 1940s for its ability to leap into the air loaded with 14 people and their parachutes. It's a beautifully proportioned workhorse, a kind of aerodynamic grain truck. My fellow Red Army paratroopers looked nonchalant. Steady exhalations of frosted breath disappeared between their knees in the center aisle. The trooper next to me, an unshaven man with red-rimmed green eyes, told me in a French-English patois that he had been to Paris once. I babbled "interesting" about 20 times in that four-minute ascent.

Suddenly a klaxon bellowed a warning that we were approaching the jump zone. The alarm vibrated in my chest and I felt my heart pump harder. At the left rear of the airplane a red light glowed on the bulkhead over the shoulder of the burly jump master. He swung open and secured the heavy door, flooding the cabin with light and wind. The red light went dark and the yellow light next to it started blinking, the horn hammered intermittently like an alarm left over from World War II, and the seven army paratroopers on the left side rose and crabbed, slightly bent, toward the door. Then, at the steady blare of that damn horn and a steady green light, the head-to-butt line of paratroopers jumped out in the 100-mph winds and tore off earthward.

All of us on the right side rose. The six guys ahead of me disappeared out the door. *"Pashal...Pashal...Pashal...,"* the jump master yelled as he gave each trooper a thump on the parachute. Last in line, I placed my left foot on the threshold, grabbed the door frame, and was making my move when I was jerked back into the airplane and spun around.

The jump master stared at me, eyes wide with anger and fear. With the door open, the light and wind at my back, and my every cell gorged with adrenaline, my thoughts flashed in a wild response of panic. *Russians. Cold war. Enemies. Outnumbered. They packed the chute.* As a child in the 1950s I had been terrified of sudden shadows. Every airplane too high to identify threatened annihilation. Every contrail was a Russian bomber.

Kiselov stepped past the jump master, slowly reached for my hand, and carefully pulled me away from the door. He tapped my wrist altimeter and circled his index finger in an ascending spiral. His eyebrows arched, asking me to understand, and his blue eyes were as serene as ever. We sat. The pilot, looking down from his perch in the cockpit, gave the thumbs-up and pushed the throttle a touch. The Antonov bucked and we banked up into the thin clouds.

I sat cursing inwardly, and as my pulse slowed I regretted my unworthy thoughts and was amazed at the depth of my residual cold war fears. The jump master reached out the door and gathered in all the static lines that had pulled the paratroopers' chutes open for them. Keeping his back to me and shaking his head, he slammed and latched the door, then turned and looked me over. Finally he half-smiled and gave me the thumbs-up, a gesture that said *At least you're willing to jump.* It occurred to me that Kiselov must have explained that I wasn't supposed to jump with the paratroopers, but this information hadn't gotten through. He was studying me; he tried to act casual, but he remained wide-eyed. After a bit he winked and nodded soberly, grooming his gray mustache, hiding a grin.

When the klaxon brayed again, I knew it was for me. I stood facing Kiselov and in a quick review composed entirely of gestures he reminded me: "Jump. Look up. Canopy must be round and full. If good, pull red cord so reserve chute doesn't open automatically. Feet together and strong when you land." The horn pounded through all the other noises. I put my left foot on the edge of the door, felt the wind tugging at my toes, saw a strangely tilted landscape far below, felt a thump on my parachute, and jumped.

I was engulfed, unutterably shocked, in a grayness to which I was completely unattached. For a few seconds I was senseless. Then in rapid succession my senses returned. The roar of the Antonov receded. I felt a tug from my crotch through my chest and shoulders, looked up, and saw I was at the center of a descending spiral of strings suspended from the gorgeous dirty-white canopy. I laughed out loud when the unwinding shroud lines put an almost comical rag doll twist on me. The air tasted minty the way it does when you suck in hard and fast. Then, from above and behind me, I heard Kiselov shouting urgently. I pulled the red cord to disarm the automatic release on my reserve chute.

Noises rose faintly from the aerodrome below. From my elevation I could discern the layout of the place. The airfield and jump zone are cut squarely

The jump plane's unadorned interior offers bare steel bench seats and a heating system unequal to its task.

A skydiver decides to jump long before he faces the open door. The paratroopers exit in rapid succession.

into the vast plain of pines and birches that surrounds Moscow. The barracks, mess hall, parachute packing rooms, and other buildings are scattered throughout the forest at the southern edge of the airfield. The night before I hadn't seen any of this.

We had arrived late, after dinner. When the men shuffling out of the *stolovaya* (mess hall) recognized Kiselov's car, there had been a foot-stomping, moonlit reunion on the icy footpath in front of the barracks. Kiselov, as parachuting trainer of the cosmonauts, a world champion at the sport with more than 8,500 jumps to his name, is something of a legend in this place, but he was greeted more as a pal. I had understood little except the spirit of this meeting, but it was a heartwarming demonstration of the affection and respect with which Russians can treat one another. Comradeship is nurtured.

We had then gone into the barracks to a two-bunk room, sat knee to knee, and drunk a little vodka. Alexander Parfenov, the most senior of the instructors, opened his tiny refrigerator, revealing half a jar of pickled tomatoes, a slice of bread, some wrapped candy, and a sheath knife. True to custom, he insisted we eat his tomatoes and sweets to temper the effects of the vodka.

Talk turned to the breakup of the central government. The folks at Voloslova don't even know who owns the airplanes they fly and jump from. They are sure that the ground they land on is Russia. But from the ground up, ownership of the equipment and even buildings is an open question. As long as they can keep training the paratroopers, they can obtain fuel rations. They get food any way they can. They intend to just keep on living like a kind of tribe, a commune of skydivers.

Their situation reminded me of some things from my own past, and although I did not understand many words that night, I believe I understood many feelings. I had spent 10 years working with draft horses and heavy equipment, logging in the forests of Montana and Oregon. I know the habits and spirit cultivated by people who work with machinery and rigging in life-and-death situations. Our priorities were staying alive and enjoying the work. Money was down the list a ways. That first night in Voloslova, in that cold-water barracks, in the company of men who endure a monastically simple existence to live as aviators and skydivers, I knew that I was in a safe place with people who take care with each other.

And as I floated back down to this backwoods Russian aerodrome, I knew that this essentially untutored jump wasn't the least impulsive.

Then the forested edges of the airfield and jump zone widened beyond my circle of vision and I stared down at the patch of hard-packed snow coming at me fast. When I was at about the height of a five-story building I locked my legs together and bent and tensed them. No fall I have ever taken could have prepared me for the landing.

It's not as I've been told, like jumping from a desk or garage or some other stationary height. This was like stepping backward off the top of a loaded hay truck going fast.

My ignorance of parachuting again left me to my own devices. I didn't collapse my parachute when I landed. The breeze-filled canopy dragged me across the snow for about a hundred feet until I pulled in a few arm's-lengths of shroud lines. I clamped my teeth on the lines I pulled in while I reached ahead to grab some more.

Finally the canopy collapsed and I got to my feet. I shed my harness and emptied the snow that had been plowed up inside my jacket. I rolled up my parachute as Kiselov had shown me in a drawing that morning.

He walked up with his own gear already stowed and slung over his shoulder and helped me stuff my chute into the bag that had been lashed under my reserve chute. We were careful not to let too much snow get in the bag with the parachute. "Tom," he said standing back a bit and smiling a benediction, "*Mala dyetz, mala dyetz*" (fine fellow).

Both exhilarated, student and instructor congratulate each other after the first jump.

In the Red Army training center at the Voloslova aerodrome, cold weather is the most constant companion.

We dropped our gloves in the snow, laughed, shook hands, and jerked each other into a back-slapping bear hug under the overcast sky.

When we turned to walk back to the staging area Kiselov had the good manners not to acknowledge the strange slash of a track I had left when I was dragged through the snow. Back at the staging area a bunch of people congratulated me and I was given the medal Soviet army paratroopers receive when they make their first jump. Kiselov introduced me to Irina Tivelkova, wife of the aerodrome's chief, who speaks English very well. She quickly explained that I wasn't supposed to jump with the paratroopers because I was using a different canopy, one that drops faster, so I could have fallen on one of them and collapsed his chute.

We went back to the barracks for tea and lunch. While we waited for the water to boil, Kiselov asked if we could listen to the recording I had made. Another English-speaking friend said she'd try to translate. My voice came across the background clamor of engine noises, klaxon blasts, and wind pretty clearly. We laughed at all the times I said "interesting." My recorded descriptions of the aerodrome, the people, the hardware, aircraft, and weather, however, sounded oddly terse, as though I was avoiding the high notes.

Kiselov seemed agitated. He asked about my emotional experience. I lamely explained that as a reporter I usually wasn't expected to recount my personal feelings. "Of course," he said, "but your emotions today might be important for you to remember." He made a hand-to-heart gesture, glanced meditatively at an egg he was holding, then fixed me with a placid smile. "Tom, you are learning to trust," he said, watching me carefully. "We jump to understand trust."

In my emotional state—still exhilarated from the jump, a little shaken from the misunderstanding in the aircraft, and strained by days of struggling with language—this final lesson, delivered so earnestly by this wiry Soviet army colonel, overwhelmed me. With those few words he dispelled the cold war. A lifetime of Russophobia washed out of me in a tearful purge. I had come here with Kiselov unable to communicate at all verbally. I trusted him unconditionally; I put my life in his hands, and he had lightened it and shined it and handed it back.

I tried to write my feelings then. I didn't feel brave or adventurous. You can't muscle your way through a half-mile fall. I wrote that all I learned on a physical level that day was the terrible feeling fledglings know that first time they step from the nest.

Jumping was a cogent choice insofar as I had managed a series of small acts that a person I trusted wanted me to accept. Acceptance accumulates. I thought at the time, and still do after nine jumps, that skydiving is, as they say, fearfully absurd, a violation of instinctive precepts of survival. But it is controllable. It's something to get to know. As practiced and taught by Sergei Kiselov, skydiving is an act suffused with heart.

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Un tragico scontro nell'aria. *All'aerodromo di Detroit, due aeroplani commerciali, che volavano ad un'altezza di circa* **150** *metri, si sono scontrati e sono precipitati al suolo. Il presidente di una compagnia d'aviazione,* **Kreiler**, *è rimasto ucciso sul colpo, un capitano aviatore è morto per le ferite riportate, e un passeggero si trova in condizioni disperate.* (Disegno di A. Beltrame)

Terror *in the* Skies!

These Italian tabloids didn't have Chuck and Di to kick around—so they had to make do with aviation.

by Karen Jensen

If one judged only from the covers of the Italian newspaper *La Domenica del Corriere*, it would be easy to conclude that early aviation was a flamboyant failure: a danger to humans, plants, and animals alike (although vultures seemed particularly at risk).

"A good number of the covers in the first years of the century were tied to the conquest of the air," the tabloid (whose name roughly translates as *The Sunday Courier*) reported in an 80th birthday salute to itself in 1979. "According to journalistic law, which states that 'news' is essentially bad news, the illustrator of *La Domenica* produced an interminable series of disasters...."

Usually that illustrator was the lean and dapper Achille Beltrame. For 45 years, from *La Domenica*'s first issue in 1899 until he retired in 1944, he turned out 4,652 front and

Aviation in La Domenica *involved tragedy (the "tragic encounter in the sky," opposite) and narrow escapes (a pilot and his* marconista*—radioman—leap from their burning airplane, above left). The "ugly surprise at dinner" (above right) mixed both. Although the illustrations weren't drawn from life, artist Achille Beltrame, creator of most of these images, relied on a large archive of photographs for accuracy.*

In April 1932 the tabloid offered readers this "singular aviation incident" (right). According to the paper, the passenger survived the treetop landing, although the pilot was found "near death." Birds were also at risk, whether in a solo attack against a Caproni bomber or making a coordinated assault on a passenger plane over Palestine.

back covers. *La Domenica*, like its imitators used other artists, but none achieved the recognition Beltrame did. During his lifetime he was accused of indulging the masses, but hindsight has heralded his art as something of a precursor to television. In an age, as *La Domenica* put it, "not yet invaded by images," Beltrame did for the tabloid's readers what television and photojournalism do today: he brought drama into the home and turned readers into eyewitnesses.

The market was ripe for his kind of talent. At the time of *La Domenica*'s founding, the newsstand had just emerged in the United States and Europe as an effective way to sell newspapers and magazines, according to Thomas Leonard, associate dean of the University of California at Berkeley's graduate school of journalism. Covers took on an unprecedented importance, and the Italian tabloid, with its eye-grabbing art, became part of a "generation of efforts to rope in readers," Leonard says. *La Domenica* differed from most of the others, however, because it never used photography on its covers; until it ceased publishing in the 1980s, it relied solely on art to lure its readers.

The tabloid's caption writers did their best to complement the cover's drama. Beltrame's rendition of two airplanes colliding over Detroit (p. 64) is a "tragic encounter in the air"; a French military aircraft diving into a family's peaceful alfresco meal (p. 65) is the


IL MATTINO ILLUSTRATO

Anno VII - N. 46 - NAPOLI, 17 - 24 Novembre 1930 (IX)
SI PUBBLICA OGNI SETTIMANA - PREZZO CENT. 40

Un fosco dramma nel cielo di Sidney (Australia): la signora Editta Morton, colta da improvvisa follia durante il suo primo volo, si scagliava sul pilota per strozzarlo, ma questi, svincolatosi, riusciva miracolosamente a dominare l'aeroplano e ad atterrare....
(disegno di UGO MATANIA)

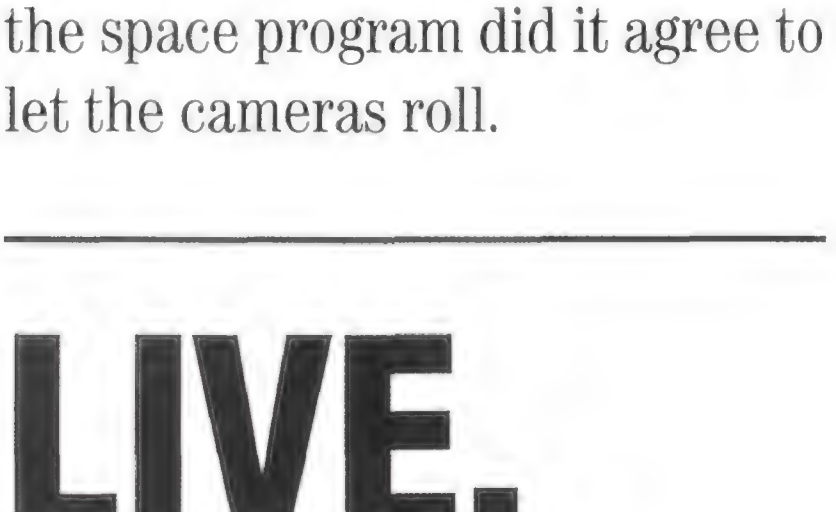
Things looked grim for this Australian pilot and his apparently insane passenger, but the caption writer assured readers that all ended safely.

somewhat understated "ugly surprise at dinner." The more bizarre the incident, the more vivid the writing. In the caption beneath an illustration of an encounter between a Caproni bomber and a vulture (opposite, bottom left), the writer tells us "the beak of the wild beast struck the forehead of the pilot, who nevertheless, but with great effort, managed to land."

Perhaps most intriguing of all the Italian tabloid images of aviation was a rendition of a pilot and his frenzied passenger that adorned the cover of *Il Mattino Illustrato*, a competitor published in Naples (above). "A darkly tragic drama in the sky of Sydney (Australia)," the caption ominously begins; "Mrs. Editta Morton, taken by sudden madness during her first flight, attempted to strangle the pilot...." The writer goes on to add that the pilot, miraculously, was able to free himself and land. But, to borrow from a tabloid of more recent vintage, inquiring minds would undoubtedly want to know more.

Only after NASA finally realized how TV coverage could help the space program did it agree to let the cameras roll.

LIVE, FROM THE CAPE



UPI/BETTMANN

by Robert J. Donovan and Ray Scherer

Television producers covering Cape Canaveral during the late 1950s wanted to film as many rocket launches as they could. Unfortunately, that didn't sit well with the Air Force, then in charge of the space program. "Like most military establishments, the Air Force had a feeling that the press was an intrusion, something to be wary of," recalls NBC producer Bob Asman. Although Air Force officials had genuine concerns about security, their biggest worry was that TV crews would record the inevitable launch failures. As long as launches continued to go awry, with rockets often exploding in midair or never even getting off the ground, reporters were locked out of the cape.

James Kitchell, who headed up NBC's space coverage, decided to get around the restrictions by renting a beach house overlooking the launch pads. He set up telescopes and cam-

Adapted from *Unsilent Revolution: Television News and American Public Life, 1948–1991*, Robert J. Donovan and Ray Scherer, Cambridge University Press, 1992.

Television coverage of the first orbital Mercury flight (left) drew a record-breaking 135 million viewers, who tuned in to watch John Glenn's liftoff from Cape Canaveral on February 22, 1962. Three months later, the second orbital flight captivated hundreds of morning rush-hour commuters at New York's Grand Central Station (above).

eras on the porch, then waited for the fun to begin. Since the Air Force refused to announce launch times, "we would get a lot of people who worked at Cape Canaveral to come out and meet us behind a tree and say, 'We think something is about to go up,' " says Herbert Kaplow, who worked for Kitchell. "The way we could tell when they were near a launch was by watching the vapor that oozed from the top of the rockets. It could go on for weeks. When the venting stopped, you knew that they were within minutes of a launch. Every little while we said, 'Oops, still venting, still venting' and kept on watching. Then all of a sudden the steam would stop, and everybody would jump into action and turn on the cameras."

All that action, however, aroused the suspicion of Kitchell's neighbor, who became convinced that the cameras and telescopes belonged to a foreign espionage ring probing the American space effort. In time the neighbor became so overwrought that he hired a bulldozer to dig a ditch as deep as a swimming pool across the dirt road connecting Kitchell's house with the highway. Kitchell responded by hiring the same bulldozer operator to fill in the ditch. Then he obtained a court order to restrain the man.

After a while it dawned on the Air Force that one way or another, the launches were going to be filmed. So the brass agreed that when a launch was imminent, reporters, photographers, and camera crews would be transported to an observation area on the base that was equipped with 20 telephones. A major was on hand to distribute press releases exactly one minute after liftoff, and in a somewhat futile attempt

NASA

Astronauts became instant celebrities and the networks rushed to record their moments in the spotlight, including President John F. Kennedy's White House reception for Gordon Cooper following his first spaceflight in 1963.

to control the release of information, the telephones were kept switched off until the minute had elapsed. TV crews then made a breakneck dash to chartered planes waiting on Merritt Island to fly their film to Orlando or Jacksonville.

The desire to control press coverage continued even after a new agency, with an official mandate for openness, assumed stewardship of the space program. In response to fear generated by the launch of Sputnik in 1957, President Dwight D. Eisenhower had proposed the legislation that in 1958 became the National Aeronautical and Space Act, which established NASA. The Space Act had a provision to ensure that manned spaceflight would not be veiled in secrecy: "The Administration [NASA] shall provide for the widest practicable and appropriate dissemination of information concerning the activities and the results thereof."

Nonetheless, NASA soon clammed up. In 1961 Edward R. Murrow, director of the U.S. Information Agency, wrote to NASA administrator James E. Webb to inquire about equipping manned spacecraft with television cameras. Webb referred the query to Abraham Silverstein, who was in charge of the Mercury program. In a memo Silverstein replied: "The use of television in our manned flight program must await future flight projects when adequate booster capability will be available to carry the increased payload and when an integrated-communication system can be designed, developed and suitably tested."

For a long time the implied themes of the Silverstein memo were repeated to the networks: It was too late to change designs. Installing cameras would delay flight schedules. Astronauts' safety would be compromised.

NASA engineers also had objections. Television aboard spacecraft would have no scientific value. It would drain electric power and interfere with the astronauts' work. It would take up valuable time and add weight to the spacecraft. The astronauts, some of whom were former engineers and test pilots, often went along with these arguments. On some occasions, even when others at NASA agreed to install cameras, astronauts would use their authority to eliminate them. They felt they had enough to do in space without operating television cameras.

If the people at NASA felt they could hold the line on press coverage, they had underestimated the television networks, whose troops moved like a new kind of army into Cape Canaveral and Houston, where the Manned Spacecraft Center (now the Johnson Space Center) opened in September 1961. NASA officials quickly felt the weight of this deployment when the television army rolled in with tons of equipment as well as heavy demands for just one more camera on a pole here or another crew there. Network teams, which included cameramen, soundmen, reporters, directors, producers, auditors, finance directors, and even bankers, took over entire motels. During major missions, NASA pressrooms were jammed.

The official foe of network executives was Julian W. Scheer, NASA's public affairs director. The demands of television news were so broad and the resistance of NASA engineers often so dogged that Scheer dealt less with individual reporters and more with network producers, among them Kitchell, Robert Wussler of CBS, and Walter Pfister of ABC. They found him no pushover.

"Julian Scheer was one of the stumbling blocks we had along the way," Kitchell recalls. "There were days that he would be very supportive, very affable. And there were times he fought you tooth and nail."

On the night of the first moon landing, the pressroom in Houston was bedlam. Television cameras were everywhere, including the area where print reporters were stationed. The television lights were so glaring that reporters complained to Scheer, who asked the TV crew to turn them off. When the crew told him in so many words to go to the moon, Scheer walked over to a baseboard and pulled their plug.

Sometimes a network would make what Scheer considered a preposterous request, such as asking to land its own chartered aircraft on an aircraft carrier to film an impending splashdown. "They would come in with that kind of request no matter how ridiculous it was," says Scheer. "And then one of their producers would go back and say, 'Look, we

were turned down cold. Those bastards won't let us do anything.' And so I would get a call in the middle of the night from a Bill Leonard [an executive and later president of CBS News] or somebody like that saying, 'I've just talked to our producer down there and I want to know why you turned us down, and I'm going to go right to the White House.' And I would just say, 'Be my guest.' "

Inevitably, network pressure on NASA created friction within the agency. A dispute arose between Scheer and a subordinate, Colonel John "Shorty" Powers, who had become something of a celebrity by doing the original launch countdowns. Scheer worried that Powers, who loved to go on camera, had become too much the ally of network officials, who courted him assiduously.

"Just before the Gordon Cooper Mercury flight," says Scheer, "Shorty Powers had the feeling that the print media no longer counted and that everything should be geared toward television, that he could control access to the cameras and work well with the correspondents and that he would appear on television." During one mission, Powers caused a row by giving copies of the flight plans to the three networks while refusing to give them to print reporters. "Everybody was up in arms," says Scheer, "so I confronted Shorty and he said, 'That's the way it's going. Television guys have to know what is going on.' " Scheer relieved Powers of his duties.

CBS

Television news slowly became a partner in the space program. The two camps realized that what was good for one was good for the other. Space made for exciting television, and all the broadcast images helped sell NASA's expensive missions to the public and Congress. The Manned Spacecraft Center even agreed to assign an astronaut to each network as a technical advisor. According to Brian Duff, then the center's director of public affairs, this led to a tug-of-war, with each network trying to land the most famous astronauts. "Of course, they did not want a technical expert; they wanted a celebrity," says Duff. "And so they would argue heatedly over who they got. We finally ended up with something like a draft in the major leagues, a complicated lottery to choose an astronaut for each network."

As television became increasingly prominent on the space scene, newspaper reporters came to rely on it to find out what was going on. John Finney, who covered the space beat for the *New York Times,* reports that in the beginning the paper's trailer at the cape did not have a television set. "But we soon got one," he recalls. "It was so much easier to watch. Their cameras could get so much closer a view than we could. TV became our monitor."

And eventually one television set was not enough. When Howard Simon, a science reporter for the *Washington Post,* entered the *Newsweek* trailer at the cape, he saw three sets going, one tuned to each network. The space story "had given TV news its big boost," he says. "In a subtle way I thought of it as TV's bar mitzvah. Television was becoming a man, developing its own stories."

And leading the way in television coverage was Walter Cronkite, the most celebrated and conspicuous space reporter of the era. During his rise as the anchorman of "CBS Evening News," he seized upon the story and lavished enthusiasm on it. "He sometimes seemed more cheerleader than reporter," wrote Barbara Matusow in her book *The Evening Star.* "The 'eighth astronaut,' they called him. He frowned on stories that reflected poorly on the program."

On February 22, 1962, John Glenn orbited Earth three times. The estimated television audience was a record-breaking 135 million. Since facilities for televising Glenn's splashdown in the Atlantic Ocean were not available, the only action shown on TV was Glenn's arrival at the launch pad, President Kennedy's preparations in the White House for following the flight, and the fiery liftoff in mid-morning.

Walter Cronkite was known as the "eighth astronaut" for his unflagging support of the U.S. space program (left).

Not satisfied with one TV set, President Lyndon Johnson watched all three networks' reports of Apollo 8's splashdown on December 27, 1968 (below).

UPI/BETTMANN

NASA

For sheer drama, nothing thrilled viewers quite like the first lunar landing, which was broadcast live after NASA withdrew its objections.

Once Glenn's capsule was lost from view, it was never again seen on television screens.

The television crews had requested the right to broadcast live Glenn's running reports to ground stations, but NASA was unwilling to go that far. It insisted that each recording be cleared for security reasons before being played over the public address system in the pressroom. About seven minutes into the flight, Glenn's voice was first heard publicly as he talked with the Bermuda tracking station. Ninety minutes later he was heard reporting the sight of glowing particles outside his capsule. In the end practically all his reports were released.

The print and television coverage paid dividends in public and Congressional support at home and praise from abroad for the openness of America's space program compared with the secrecy surrounding the Soviet Union's. Recalls Brian Duff, "We at NASA more and more realized that it was in our best interests to make it as easy as possible to cover the story accurately and completely, that this in the long run was going to serve us. We worked hard at it."

And so did the networks, who had to come up with ways of illustrating the world of space to its viewers. To demonstrate weightlessness, NBC hired puppeteers to perform at the studio. "They were able to create that floating feeling," recalls Bob Asman. Another challenge was how to illustrate orbiting: NBC's Frank McGee ran a model train around studio 8-H in New York with a camera looking down from above. NBC reserved an entire hotel room, had it stripped of beds, then packed the place with space toys for Mr. Wizard-like demonstrations. "They were all numbered and lined up," says Asman, "so that whenever we were in a hold or any kind of dead time on the air, our correspondents would pick something to demonstrate."

In response to network pleas, NASA authorized live coverage of the splashdown of Gemini 10 in July 1966. But network producers wanted more. They wanted a camera in the rescue helicopter for dramatic shots of the astronauts climbing out of the capsule in heavy seas and into a rubber life raft. The Navy recovery experts and Donald K. "Deke" Slayton, then chief of the astronauts, objected. Brian Duff still vividly remembers his exchange with Slayton:

"I said, 'Deke, what is it? What's the problem here? It's our NASA cameraman. It's a great picture, and we ought to have it.' And Slayton said, 'I never want anyone to see an American astronaut losing his lunch on that spacecraft.'

"I said, 'Deke, how many guys have done that?' It turns out there was no one. I said, 'Besides, if it happens, it's our cameraman. I mean, we can always point at the ocean or the

ship or something.' He said, 'We're not going to do it!'

"So I said, 'We've got to see Bob Gilruth about this.' Gilruth, the director [of the Manned Spacecraft Center], was a sort of fatherly figure. Gilruth listened to both of us and said, 'Deke, you are going to lose this one.'

"And Slayton, to give him credit, never argued the question again."

By this time the networks knew that Scheer was fighting their battles. He and his associates were well aware that throughout the years of Mercury and Gemini flights the public had become jaded about space missions and that Congress was periodically restive over the billions of dollars in space appropriations.

In 1969, a few months before Apollo 11, the first lunar landing, Scheer demonstrated his allegiance to TV coverage when a conflict erupted that threatened the whole show. George Low, the Apollo program manager at Houston, objected to having a television camera on board.

"Low called me and said, 'That camera weighs too much and we can't get it on,' " Scheer recalls. "I said, 'Well, George, then you'll have to take something else off.' "

Scheer won out after getting the strong support of NASA administrator Tom Paine. "It was my feeling," says Scheer, "that it would be the height of ridiculousness, absolutely inconceivable, to have the capability of live pictures from the moon and not do it."

Scheer's instinct was correct. Six hundred million viewers around the world reveled in the sight of Apollo 11 astronauts taking the first steps on the moon.

For pure drama none of the six subsequent Apollo missions could equal Apollo 11, but that didn't keep the networks from trying to score another ratings hit by broadcasting Apollo 12. Unfortunately, disaster struck when astronaut Alan Bean, in setting the camera up on a tripod, pointed it directly at the sun. The camera conked out. "We did not know the sun would hurt TV," said Bean later.

Executives at the three networks, furious that they had nothing to show, attempted to salvage the situation by falling back on simulation and improvisation. ABC put on the air two test pilots who acted out everything the real astronauts told mission control they were doing on the moon. CBS staged a detailed simulation from the Grumman plant on Long Island. NBC showed a full-scale mockup of the lunar module and, once again, put on a puppet show.

The grand finale came in December 1972 with Apollo 17. Because the public had seen it all before, the networks planned selective coverage restricted to brief interruption of regular programming. NASA, concerned that television was giving the space program short shrift, proposed that public television cover Apollo 17's moon explorations. Public television said no.

The networks' dwindling space coverage drew no complaints from viewers. In fact, when CBS preempted the last 17 minutes of its prime-time "Medical Center" to broadcast the night launch of Apollo 17, many viewers phoned in afterward to inquire how the plot of "Medical Center" had turned out.

NASA engineers had become so dependent on television coverage for their operations that in 1974 they developed a television system of their own. The agency completely took over the televising of all space programs, including Skylab and the shuttle, and made its live pictures and film available to the networks.

In the early days of space coverage, the networks debated what to do if an accident occurred while a mission was being televised. They decided the cameras would keep rolling. "It was felt that it was part of the coverage, however tragic, and that we could not go to black and make believe it didn't happen," explains Chet Hagan, chief producer of NBC's space coverage. NASA adopted a similar policy in the early 1980s for its own television system. Robert J. Shafer, NASA's television director, stipulated that coverage was to continue as long as there was anything to see.

On January 28, 1986, there was definitely something to see. CNN, the only network to do so, broadcast live the liftoff and subsequent explosion of the space shuttle *Challenger,* which killed everyone on board: six astronauts and Christa McAuliffe, a New Hampshire schoolteacher. In that cruel hour, television news showed the fiery devastation in the sky and the mute desolation on the faces of McAuliffe's parents, watching from a grandstand below.

"Once again," wrote John Corry in the *New York Times,* "television was the great American hearth. The assumption was that we were all one family." If *Challenger* had exploded in outer space beyond the eye of the camera, television could not have done more with the story than newspapers did. But the camera caught the explosion, and the image utterly transcended the written word. It is the image that sets television apart.

The first live images of the moon enchanted even the tiniest viewer, but public interest in NASA's engineering feats eventually declined.

UPI/BETTMANN

SURVIVAL 101

A fiberglass tube roughly the size and shape of a helicopter's cabin hangs above a swimming pool at Pensacola Naval Air Station in Florida. Inside the tube four men and a woman in flightsuits, helmets, and boots strap themselves into troop seats. There are openings where a helicopter's doors and windows would be, but the interior of the "helo dunker" is dim. Some of the students look nervous. They are about to simulate an escape from a helicopter that has ditched at sea—frequently a fatal event until the Navy instituted this kind of training.

In the water, dark shapes wait—divers trailing air hoses and intercom lines to a control station beside the pool. Suddenly, cables go slack and the dunker hits the water and begins to sink. As they've been trained to do, the students reach for the edges of the openings. The dunker, now completely submerged, rolls upside down. For what seems a long time, the students remain hanging in their seats, waiting for all violent motion to stop. They grip the windows, not out of fear but to maintain their orientation. At night in a submerged helicopter, the exits are hard to find and the reflexive tendency to use both hands to release a harness can be fatal. Finally, the students unstrap and pull themselves out instead of swimming—an accidental kick could drown someone else. After no more than 20 seconds, all the students are swimming for the side of the pool.

All Navy aircrew undergo some form of survival training and are required to pass a water survival test. Although the words "survival training" conjure up a grueling struggle, few students seem to have much difficulty with it. Actually, most of the training is easy to understand and follow. An old Navy study to measure the effectiveness of the training showed that between January 1969 and February 1975, 107 of 117 trained pilots—91 percent—survived being downed, compared with 33 of 50 untrained pilots—only 66 percent. Survival rates for crewmen were somewhat different from those for passengers, and the statistical base wasn't large enough to be precise, but few aviators doubt the training saves lives.

MEDFORD TAYLOR (2)

Multicolored smoke billows from signal flares as a water survival class practices using the equipment they will routinely carry on overwater missions (left). All Navy airmen are required to undergo the training and pass a rigorous test (above).

Here at Pensacola another dunker replicates the nose section of a fighter. It slides along on rails and pitches forward when it hits the water, an effect that's intimidating to anyone not trained for it. Actually, the Navy would rather see its pilots eject from a fighter than ditch. During the propeller era, a pilot could ditch at comparatively low speed with a good chance of surviving. Jets hit the water at much higher speeds, and their air intakes scoop water, stopping the airplane almost instantly and often flipping it over or breaking it up. But ejecting isn't always possible.

During carrier operations, an arresting cable can break after having slowed a landing aircraft enough to prevent the pilot from taking off again. A "cold" catapult can launch an airplane with insufficient force and toss it into the water. Sometimes a pilot will simply stay with a malfunctioning airplane too long. If the crew members don't have ejection seats effective at zero airspeed and zero altitude, they have no choice but to ditch and try to escape from a rapidly sinking airplane.

Yet another dunker simulates a parachute's many lines and yards of clinging cloth, which can entangle and drown a pilot. Very slow sinking currents can drag a parachute below the surface with a force of four or five tons. Solution: ditch the chute fast. If the pilot is injured, a seawater-activated release mechanism is designed to release the chute upon immersion in water.

Today's students are taught to release the chute harness just as their feet hit the water. The old way was to release earlier, which was fine for avoiding entanglement, but people sometimes released too high because of difficulty judging distance. The students learn to sink down and away from the shrouds and to make sure they're free of entanglement before they start to swim. Each student is strapped into the harness, dangled over the water, and dropped. The canopy settles like a silk mushroom, and a few seconds later the student pops to the surface.

The Navy will teach a non-swimmer to swim, and most students pass the test. Navy data shows a consistent washout rate of less than one percent over 30 years. But even trained swimmers have trouble in the water when they're wearing boots and flying clothes. Since March 1988, when airman recruit Lee Mirecki died during water survival training, there's been a heavy empha-

by Fred Reed

Most military aircrew recruits don't know what to do if their aircraft crashes. So they go to school.

MEDFORD TAYLOR

Pensacola's "dunkers" train airmen to cope with suddenly finding themselves underwater in an aircraft.

sis on safety. An autopsy found that Mirecki died of "extreme fear, exhaustion, and lack of oxygen," causing cardiac arrhythmia. The resulting furor ended the old boot camp regimen and forced a review of safety measures. Anytime today's students feel apprehensive about safety they can stop the training.

Once the pilot is safely down in the water, what happens next? Though the Navy doesn't say so explicitly, the answer is: *Let us know where you are and stay alive until we pick you up—a couple of days at most, but probably only a few hours.* So much for the idea that downed pilots may have to live for months on a diet of bugs and monkey.

A March 1972 Naval Safety Center study during the war in Vietnam revealed that in the three preceding years not a single downed airman had been forced to find his own food. Of fliers rescued after being downed, 97 percent were picked up within 24 hours; the rate for non-combat rescues was 99 percent. The pilots' radio beacons have made it easier to find them, and flights are also monitored much more closely than they used to be.

Fliers carry more than just radios, though. Their survival kits vary by service, by aircraft, and by mission. Large aircraft carry rafts for several people.

Fighters have one-man rafts in the seat pans of their ejection seats. Most carry a voice radio as well as the beeping beacon and a flashing strobe light that can be attached to a helmet. Most survival kits provide fish hooks, first aid, flares, a dye marker that creates a large yellow-green blotch in the water, water purification tablets (no good for seawater but useful on land), and matches. Some kits contain a condom, which can be put inside a sock for reinforcement to make a water bottle. Nobody carries shark repellent anymore. It turned out the stuff just didn't work.

Some of the equipment is fairly sophisticated: rafts inflate automatically on contact with water, and the strobe comes with a blue filter so that the flash won't be mistaken for gunfire by rescuers, as well as an infrared filter to make the light invisible to anyone not equipped with night-vision devices.

When the students have been through the dunkers, the training becomes increasingly realistic, moving from the swimming pool to open water. The students practice inflating their rafts, climbing into them, caring for the injured, and signalling for help. On this day, the students are newly commissioned officers. A boat moves slowly across the bay, dropping off students clad in flightsuits and life preservers. A couple of hundred yards behind it, a helicopter hovers over each student in turn and lowers a line. The noise is terrific, and the downwash turns the surface into spray. Each student hooks up to the line and rises about 20 feet above the surface before being lowered back into the water for pickup by another boat. No one seems to have any difficulty, and the finale is a parasail ride behind a power boat, simulating a parachute landing at sea.

The Air Force conducts a 17-day land

Lindbergh's New York-to-Paris Survival Kit

I had an Armburst cup which is a device for condensing the moisture from human breath into drinking water. The cup is cloth covered and contains a series of baffle plates through which the breath is blown. The cup is immersed in [sea]water and then removed and blown through. The evaporation of the water on the outside cools the cup walls and baffle plates on which the breath moisture collects and runs down to the bottom of the cup.

The following is a list of the equipment carried on the flight:

2 flashlights
1 ball of string
1 ball of cord
1 hunting knife
4 red flares sealed in rubber tubes
1 match safe with matches
1 larger needle
1 canteen—4 qts.
1 " —1 qt.
1 Armburst cup
1 air raft with pump and repair kit
5 cans of Army emergency rations
2 air cushions
1 hacksaw blade

from We—Pilot & Plane
Charles A. Lindbergh

NICK GUNDERSON

Although they don't train in the desert, students at Fairchild Air Force Base can view a classroom scenario.

survival and prisoner-of-war training course in the Colville and Kaniksu National Forests, about 70 miles from Fairchild Air Force Base near Spokane, Washington. The school at Fairchild opened for business in 1949, when General Curtis Le May of the Strategic Air Command became concerned that the crews of long-range B-36 bombers might be forced down anywhere in the world.

Not much has changed since Le May's time. The formal content of the modern course, taught by the 3636th Combat Crew Training Wing, is still based on finding food, water, and shelter, signalling for help if you can and using a compass if you can't. The emphasis on long-term survival is curious, given the extremely low number of downed airmen who need it, but both the Navy and the Air Force teach it.

An implicit goal at Fairchild (and at Pensacola) is to get people from the city or suburbs used to the idea of being alone in the woods. Classroom lectures provide theory, and the field days are for practice. Most of it is common sense (follow animal trails to locate drinking water), but like much of military training, the survival school throws too much at the student too fast. In his time, Le May didn't seem concerned. He wrote: "[T]hey garner a good deal more information than they can perhaps retain. Some of it, however, stays with them, and more will come back to them as they need it.... The basic and most useful impression that they derive, I think, is that neither jungle nor desert nor Arctic is as nightmarish as portrayed in pulp fiction."

Printed handouts explain that water can be obtained by hollowing a cup in the stump of a freshly cut banana tree and waiting for it to fill, wrapping a plastic bag around vegetation to collect the transpired water, or digging down into the outside bend of a dry river. But just as important as the specific information contained in the curriculum is the degree of psychological comfort in the wild that results from an acquired belief that survival is possible.

The field school is taught by specialized survival instructors, mostly enlisted men in their early 20s. On rare occasions, higher ranking officers have had trouble with the idea of a junior sergeant telling them what to do, but these are no ordinary junior sergeants. Colonel Dave Merriman, commander of the 3612th Combat Crew Training Squadron, has no problem with his faculty's rank. "These guys are the experts," he says. "My job is to make sure the instructors get what they need to do their job and stay out of their way." Instructor school, voluntary and highly selective, lasts almost six difficult months and produces fine woodsmen—and divorces. "These guys spend a lot of time with students, away from their families," Merriman explains. "On their days off, they want to go back to the

NICK GUNDERSON (2)

At Fairchild, "survival" covers everything involved in preserving human life, from parachute technique (left) to a ride on a helicopter's hoist.

woods with their buddies for bow hunting or whatever. It makes for domestic strain."

When it is pointed out that the Boy Scouts taught this stuff thirty years ago, older instructors nod their heads ruefully. Air Force chief Chuck Lovelady reaches in his pocket for what has become an uncommon implement. "Nobody carries a pocketknife anymore," he says. "Americans just don't grow up hunting and fishing like they used to. So, yeah, we deal in basics."

For the field course, an instructor has four students, each equipped with a knife, a canteen, and food. The students on this day are reserves, and they're barely interested. According to instructor Eric Zrucky, "We get some highly motivated guys. Like most pilots. But for lots of these guys, this is just a square they have to fill. They don't believe [a survival situation] can ever happen to them."

The other extreme could also be a problem. Some of the most fiercely determined people in the military come through this school. But there have been only two deaths: one man concealed a bleeding ulcer; another succumbed to hypothermia.

"Drink water!" shouts a student designated the "water monitor." The order is repeated periodically, and without enthusiasm the students reach for their canteens and drink. The students in the woods are doing nothing particularly strenuous, and the instructors admit they don't drink water that often except when students are around. But the students are supposed to be "encouraged" to drink water, and rules are rules.

An unstated purpose of the course is to convince the students that all manner of things can be improvised. (Sometimes it goes overboard: "Chew on wild mint to get that fresh breath.") After the students have set up a neat camp and gathered firewood, the instructors tell them, "Okay, make something. It can be anything useful. A spoon. A way of keeping animals out of your food. It better be something real. I don't want some guy holding up a rock and saying, 'This is my killing device.' "

The next morning, Zrucky finds an ant nest. "Chow," he says, grabbing a black ant and popping it into his mouth. "Okay, guys. Bugs are food. There may be times when you don't have anything else. Pull their heads off before you eat them or they'll pinch hell out of your tongue. Try one?" Students are not required to eat anything, but a couple try it. "They taste like lemon," says Zrucky. "It's the acid. You can squeeze them into water and make lemonade."

The instructors say it isn't important that students actually eat bugs in training—just that they know it can be done. "Really what we're teaching is attitude," Zrucky says. "We don't expect them to go home and eat ants in their back yard. But they know it's a serious possibility. The fact is, some guys will just die before they eat what's out there. That's what we want to avoid."

SETI Takes the Hill

by William Triplett

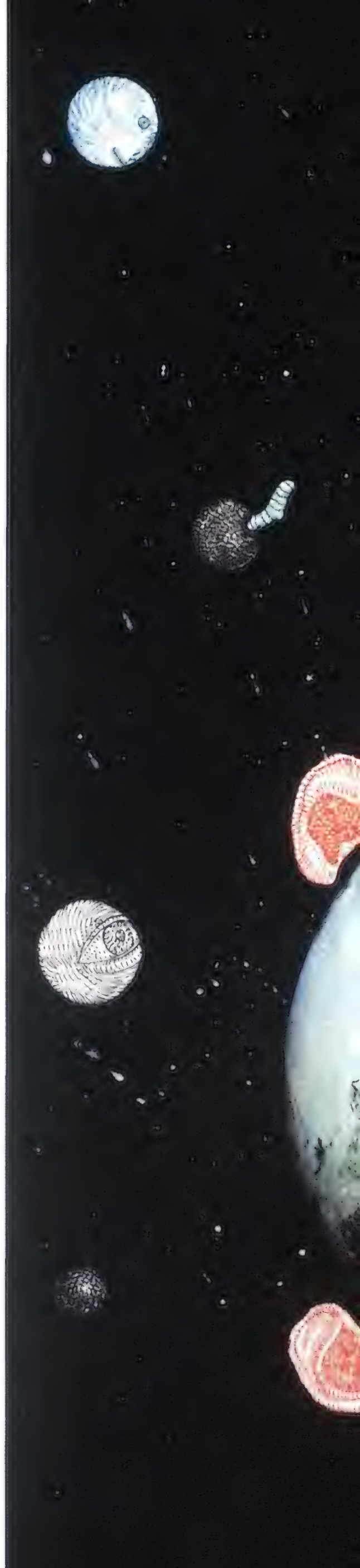
Illustrations by Alan E. Cober

On June 28, 1990, the little green men came back to haunt Jill Tarter. Early that morning, she received a call at her California home from Washington, D.C. "My God," her colleague on the other end of the line said, "do you know what's happening?" Tarter, the project scientist for NASA's $6.1 million search for extraterrestrial intelligence (SETI), had a pretty good idea. This was the day the appropriations committee of the U.S. House of Representatives was to decide whether to go ahead with the controversial search, and Tarter was ready for bad news.

Three thousand miles away, Representatives Ronald Machtley and Silvio Conte were introducing a last-minute amendment to kill the funding that Tarter and her associates had worked so hard to get. "We are just beginning to realize the costs associated with the S&L bailout," opined Machtley to his colleagues. "Might we spend some of this NASA money to find where the absence of intelligence was that led to this failure?" Citing the very earthly $200 billion budget deficit, Machtley added, "If SETI does proceed, I suggest that we adopt the SCOTI Program. The SCOTI is the search for congressional intelligence."

Conte wondered why taxpayers should fund this "rip off" quest for "little green men with misshapen heads" when for a measly six bits—instead of six million bucks—you could get "conclusive evidence" at any supermarket check-

The search for signs of intelligent life in the universe begins in Washington, D.C.



out counter. He then cited several articles from the *Weekly World News* reporting on space aliens stealing frogs and UFOs trying to land at Chicago's Soldier Field.

Case closed, with minimal fiscal expense.

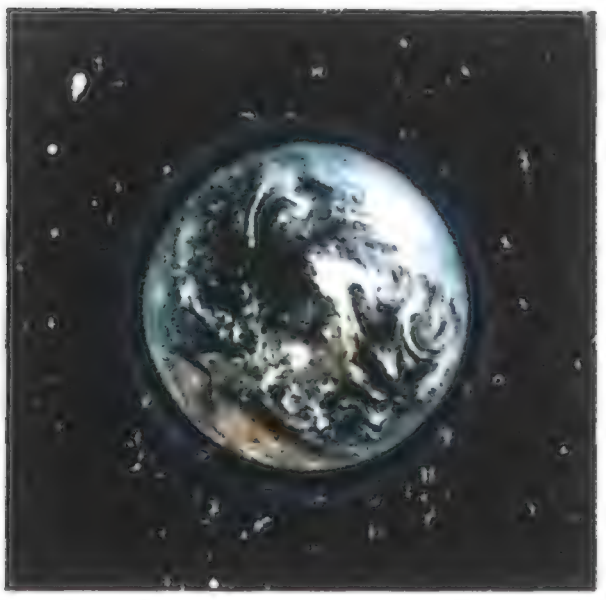
Congress has been ridiculing SETI for the past 20 years, so it came as no surprise to Tarter that the Machtley amendment passed. But it did hurt. SETI, its supporters wearily point out, is not, never has been, and never will be a search for little green men or UFOs, but this has never stopped Capitol Hill from withholding money desperately needed to mount any kind of substantive search.

The SETI community says it is driven by the ageless question of whether we are alone in the universe, and the cosmological, philosophical, and even theological implications the answer may hold. The search dates back to 1960, when Frank Drake, a 30-year-old astronomer at the National Radio Astronomy Observatory in Green Bank, West Virginia, derived an equation that attempted to calculate the number of habitable planets in the universe (see "Is Anybody Out There?," p. 86). Encouraged by his results, Drake aimed a radio telescope at a nearby star, tuned in to a radio frequency, and immediately detected a strange signal. Hopes fell, however, when further investigations identified it as a secret military communications test. Drake tried other stars and frequencies, yet each time turned up nothing, effectively establishing a pattern that has been both the bane and inspiration of the SETI community ever since. There have been more than 50 subsequent SETI efforts, including one that examined 700 stars, but each has turned up nothing but cosmic silence. That still leaves well over 399 billion stars to check. "We have eliminated the possibility that the sky is teeming with signals directed at us," Harvard physicist and SETI astronomer Paul Horowitz told a writer for *The Atlantic* a few years ago. "But I think that's all we have eliminated. Everything else remains speculation."

Congress took no real notice of SETI until the late 1960s, when NASA began making overtures for the funding necessary to narrow the speculation. Among

the first ideas proposed was Project Cyclops, a sprawling network of telescopes and scanners that came with a whopping price tag of around $10 billion. "That was back when a billion dollars was money," says Michael Hart, a professor of astronomy at Anne Arundel Community College in Maryland who has been active in the SETI debate. Cyclops was abandoned in the wake of sticker shock, but the damage was already done: SETI now had the reputation of being a black hole for federal money. Senator William Proxmire contributed the final blow in 1978 when he gave it his Golden Fleece Award, which he bestowed on projects he believed were bilking taxpayers.

The legacy of the notorious award continues to bedevil SETI to this day. It now besmirches NASA's latest search: the Microwave Observing Project, which is led by Jill Tarter and intends to survey the sky for microwave radio signals from an extraterrestrial intelligence. The project actually includes two complementary and rigorous radio astronomy searches, to be conducted under the overall guidance of NASA's Ames Research Center in Mountain View, California. The Ames SETI team will selectively tune in for long periods of time to some 800 solar-type stars within 100 light-years of Earth, and another team at the Jet Propulsion Labora-



tory in Pasadena, California, will conduct a catch-all listening survey of the entire sky. (see "Knock, Knock," opposite). The search is geared to microwaves because of all the frequencies of electromagnetic radiation—considered the most efficient means of interstellar communication—the microwave frequencies are subjected to the least background noise interference. In other words, microwaves are probably the quietest phone lines an E.T. would use between the stars.

NASA submitted the proposal for the Microwave Observing Project to Congress in 1988. Unlike the doomed Cyclops, the microwave project is designed to use existing telescopes, and its price is a conservative $100 million spread over 10 years.

Ten million dollars a year? That's practically peanuts in terms of federal budgets, and most of the money is targeted for developing new analytic technology. "Up to now SETI has been dependent on taking a big dump of data off [a radio telescope] and storing it on some kind of magnetic media, which you take back home and analyze later, and maybe after a few months you find something interesting," says Tom Pierson, who directs the SETI Institute, a non-profit organization performing research for Ames. But with the new generation of computer chips, he says, "you now have the ability to deal with that incredible firehose full of data in real time." According to Tarter, a radio astronomer at Ames who was officially named SETI project scientist in March 1989, the cutting-edge, super-computerized signal detection and processing systems being developed for the Microwave Observing Project are so powerful that they "will do more searching in the first minute than all other [SETI efforts] have done for the past 30 years combined."

That's good news for the SETI folks, who believe time is of the essence. "The interference environment gets worse daily," says Tarter. Everything from orbiting satellites to cellular telephones—all of which are increasing in number—fuzz up the listening spectrum with background static. If SETI is ever going to be more than a lot of intriguing speculation, a major effort has to be mounted before the spectrum is completely drowned out.

Congress approved the project in October 1989 but didn't provide sufficient funding. This is not uncommon; getting Congressional approval is easy, getting Congressional funding is hard. With no one in the White House or at NASA headquarters willing to go to the mat for SETI (despite the support of Arnauld Nicogossian, then NASA's director of life sciences), the Microwave Observing Project seemed sure to disappear into the kind of silence SETI efforts had already come to know only too well from the stars. Before an attempt to communicate with extraterrestrials could begin, it would be necessary to communicate here on Earth with Congressmen. Says Tarter: "That's when we knew we had to become politically aware."

> Drake aimed a radio telescope at a nearby star and immediately detected a strange signal.

In more ways than one. Among the first pols contacted was Tarter's Congressman, Ron Dellums. A Lockheed colleague made the initial call on Tarter's behalf, but the Congressman's staff "bristled at the Lockheed connection," according to Tarter, "because Mr. Dellums was on Lockheed's case at the time about minority hiring issues." It was the first of many lessons on how the political process works. "When you're naive about the process," says Pierson, "it's amazing just how naive you can be."

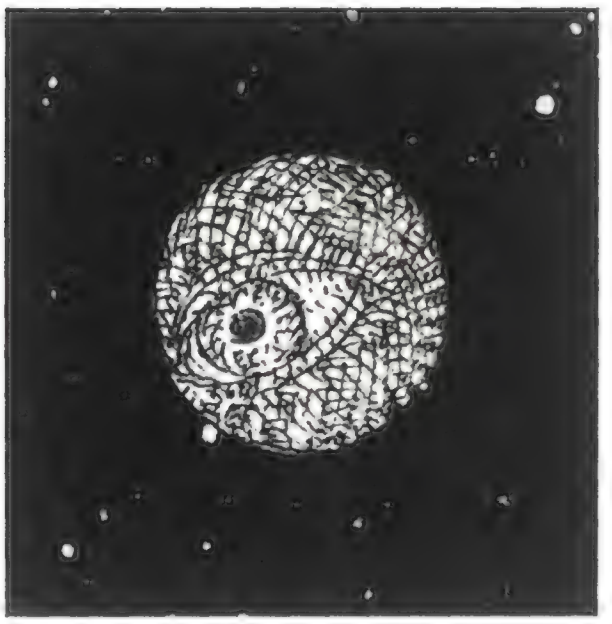
Tarter and Pierson eventually got the attention of Congressmen Norman Mineta and Dave McCurdy. The former's district is home to many Ames employees, while the latter was an ROTC cadet with Pierson at the University of Oklahoma. The staffs of both Congressmen, Tarter says, "laid out the map for us about how things work in Congress."

"Even though it's all very complex," says Tarter, "you learn very quickly that it comes down to two key offices—the chairmen of the appropriations subcommittees in the House and the Senate." Specifically, Congressman Bob Traxler and Senator Barbara Mikulski. "The problem," she adds, "is everybody

wants to get to them."

The closest Tarter got to Traxler was a telephone conversation with staffer Richard Mallow. Actually that's often close enough: as clerk of the subcommittee, Mallow is known to play a major role in decisions on NASA budget requests. Mallow had once mulled over the ageless question on his own, according to Tarter, but concluded that if other civilizations, like us, tended to use technology destructively more than constructively, they had probably already obliterated themselves and were thus not likely to be sending out interplanetary communiqués. This is a widely accepted hypothesis, and Tarter admits its unfortunate logic. However, she adds, "It would be a shame if [Mallow's] personal prejudice prevented us from even making an effort to find out."

Mikulski, or rather Kevin Kelly, Mallow's counterpart in the Senate, proved more elusive. "We tried to see Kevin but could never get an appointment," says Tarter. But in the summer of 1989, when Mikulski's subcommittee was debating SETI funding, Tarter and Pierson received some unexpected help from the appropriations subcommittee's ranking minority member Jake Garn. A deeply religious man, Garn had told colleagues at a Senate prayer breakfast shortly after his 1985 shuttle flight that "to make the assumption that this



one insignificant speck of dust called Earth is the only place that God put His children, when the universe is so large, just doesn't make any sense. There is no doubt in my mind there is life in space. And for one one-thousandth of NASA's budget per year, I don't think that's much to see if I'm right." His impassioned defense of the project turned out to be pivotal.

The biggest obstacle, however, continued to be the project's name. "The most know-nothing attacks on science research have come from people who picked on the title of the research, thinking it was far out," says Congressman George E. Brown, one of a handful of vocal Congressional SETI supporters. "The problem has always been titles and lack of understanding."

There had been no attacks since the 1978 Golden Fleece Award, but not because Congress has grown more receptive to SETI. As a small research and development effort in NASA's life sciences research and analysis budget during most of the 1980s, SETI had been all but invisible to fiscal scrutiny. But the Microwave Observing Project had the status of a separate line item in the 1991 budget, and in an era of fiscal restraint, the new SETI sounded very much like a Steven Spielberg fantasy. It was an easy target when Machtley and Conte shot it down on June 28, 1990.

Although SETI's Congressional critics have preferred to rely on tabloid headlines for testimony, SETI also has its critics in the scientific community. Michael Hart, for example, was among the believers in the Drake Equation. He grew increasingly skeptical, however, and in the late 1970s he formulated the principle of the Continuously Habitable Zone. Although no planets outside our own solar system have been discovered to provide further support, Hart argues that a planet must be positioned the perfect distance from a star in order to develop a life-supporting atmosphere. He cites as examples Earth's two neighbors, Venus and Mars, neither of which can sustain life because of their distances from the sun.

"The point is that if you take all we've learned in the last twenty or thirty years, the Drake Equation begins to shrink

Knock, Knock

So you think there's intelligent life out there. How are you going to find it? You could try shuttling from star to star, checking to see if anybody's home. Assuming, of course, you have at least a couple of centuries to spare, along with a few million megatons of fuel.

The more practical method would be to stay here on Earth and listen. For roughly a century, radio, television, and radar signals have been leaking out of Earth's atmosphere and into the cosmos. Maybe the same thing has been happening in another technological civilization. Better yet, maybe they've been deliberately sweeping the universe with an electromagnetic beacon, hoping that someone just might pick it up one day.

Either leakage or a beacon would be easy to hear if it didn't have to compete with background noise. Unfortunately, the electromagnetic spectrum in outer space can be quite noisy. One of the quieter regions of the spectrum, however, is called the "microwave window"—radio waves that lie in the frequency band between 1,000 and 10,000 megahertz. It's here that the SETI Microwave Observing Project will tune in the radio telescopes that are part of NASA's Deep Space Network.

The Jet Propulsion Laboratory's sky survey will rely on telescopes located in Goldstone, California, and Tinbinbilla, Australia, while Ames Research Center's targeted search will use telescopes in Arecibo, Puerto Rico; Green Bank, West Virginia; Parkes, Australia; and maybe others to home in on nearby stars that are thought to be capable of supporting planetary systems.

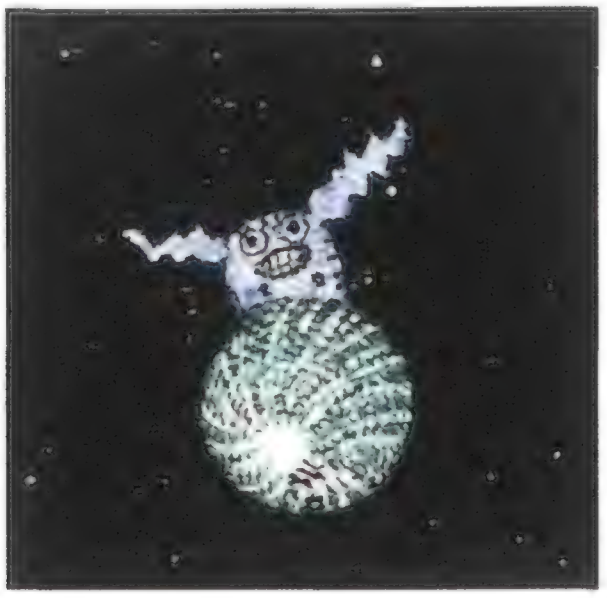
Data collected by the telescopes will be instantly fed into a computerized analyzer developed by the Microwave Observing Project. The analyzer will be able to listen to tens of millions of different frequencies simultaneously and sort the data in a matter of seconds, but there are billions of possible frequencies that might carry a signal. What the analyzer will look for is evidence of a narrow-band signal that spans no more than one or two frequencies. Natural background noise tends to be "fat," spilling across a number of bands and frequencies; a narrow-band signal would strongly suggest an artificial origin, something only a technological society could create.

dramatically in its probabilities," says James Trefil, author and physics professor at George Mason University in Fairfax, Virginia. Trefil and Robert Rood, an astronomy professor at the University of Virginia, ran the Drake numbers anew and concluded that the chance that other life exists in the galaxy is barely three percent.

That number seems to shrink even more in light of the Fermi paradox, named after nuclear physicist Enrico Fermi, who once posed the question "If extraterrestrial beings exist, why aren't they here already?" He wasn't being flip. If we can develop the technical capability for building space colonies, and we are on that threshold now, it stands to reason that others can too. And it's generally accepted that overcrowding and depletion of resources will eventually force any civilization to pursue life in space colonies. Nature will then take over and repeat itself.

"In a thousand years or so things are going to get real crowded in those colonies," says Rood. "So they'll send off more colonies, which in turn will send off more in another couple thousand years." At that exponential rate, Trefil says, colonizing the entire galaxy should take no more than 30 million years—a drop in the cosmic bucket, considering that the Milky Way is thought to be around 15 billion years old. "Any civilization that was ahead of us would've colonized us a long time ago," says Hart.

It's interesting to note, however, that to various degrees even skeptics support the SETI Microwave Observing Project. Trefil is a believer in the potential for technological spinoffs, while Rood sees the project as "a great intellectual adventure into our own origins." Only Michael Hart sounds a cautionary note. "It's probably a waste of money," he says, "though if it's a small amount of money—and 10 million dollars is small potatoes indeed—I probably don't care too much. And I would like to see something done."



'The new search will do more in its first minute than all previous SETI efforts have done in the past 30 years."

Nonetheless, over the years SETI has managed to garner sparkling endorsements from three National Academy of Science committees, as well as from such scientific heavyweights as Freeman Dyson, Stephen Jay Gould, Hans Mark, and Carl Sagan. When it comes to $100 million in funding, cleanliness is next to fiscal soundness. "Normally we expect any scientific research project to be thoroughly reviewed by the best scientists in that discipline," says Congressman Brown. "It is then further reviewed by the science managers within the appropriate agency." This ensures that a project is not only fiscally sound, but also squeaky clean. As Stephen Kohashi, an aide to Senator Garn, puts it, "By the time it gets to us it's been pretty well scrubbed."

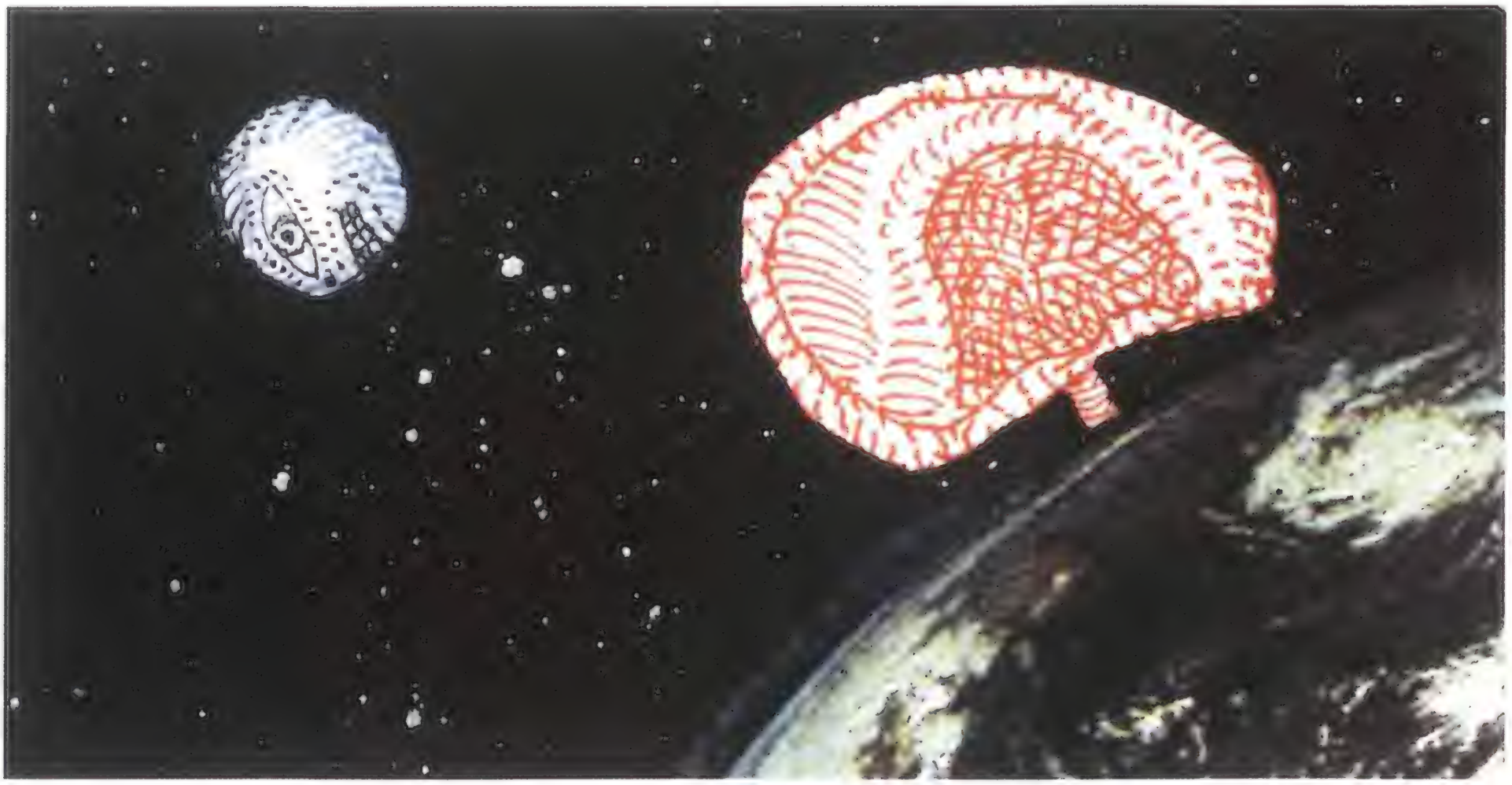
SETI has also had to compete with rivals for funding, and the Congressional subcommittees presiding over NASA oversee Veterans Affairs, Housing and Urban Development, and the National Science Foundation as well. "Even if it's good science, we have to decide whether in all our other priorities we should be funding this one," says Brown. Other NASA projects were also considered. "We have to look at how any new NASA project fits in with existing NASA projects, because you can't start funding a new project that's going to take money away from, say, a shuttle flight," says Garn.

The basic radio astronomy involved in the Microwave Observing Project was generally getting good reviews on the Hill. To help gain further support, Tarter and Pierson were also pushing the technological spinoffs to be reaped from the project. The analytic technology being developed promises to include commercial applications, and it hurt not one bit that other government agencies validated the claims. The Federal Aviation Administration has shown interest in the frequency analyzer under development for possible use in air traffic control, while the world of terrestrial intelligence—the National Security Agency, which has a fondness for any new kind of listening technology—put in an encouraging word.

By the time Tarter received her phone call that fateful June morning, SETI had found some influential friends. In the House, Traxler had decided to accept the Machtley amendment killing SETI rather than fight it with a floor vote, but that didn't mean he had withdrawn his support. "We later saw the strategy," Pierson says. "By not having the vote, Traxler laid the groundwork so that if the Senate restored the funding, the House would be in a position to accede. There would be no record of a polarized floor vote."

But would the Senate restore? Tarter tried again to get access to Kevin Kelly, and eventually he relented and agreed to see her. Tarter found him not completely uninformed, only partially so. "I think he'd heard the technological spinoff stuff before," she says, "but when I told him about how teachers and kids get hooked on this project, he looked at me and said, '*That's* the story you should be telling people!' " An elementary and junior high school curriculum, which is designed around the interest that kids have in extraterrestrial life, is currently being developed by the SETI Institute, NASA, and the National Science Foundation. This kind of educational component, which demonstrates how SETI gets young students excited about science and math, as well as Garn's influence, eventually helped secure Mikulski, the last key player.

"For some projects the scientific question being pursued is so compelling by itself that you believe the project is worth doing," says a House staffer. "But



$R_* f_p n_e f_l f_i f_c L$ = Is Anybody Out There? (The Drake Equation)

Like each of the approximately 50 SETI efforts that have preceded it, the Microwave Observing Project is based on the Drake Equation, derived by astronomer Frank Drake over three decades ago. Drake attempted to calculate the number of civilizations among the 400 billion stars in our galaxy with whom we could communicate. That number is determined by the following seven factors: R_* = the rate at which stars are born in the Milky Way every year; f_p = the fraction of the stars that might have planets; n_e = the number of the planets ecologically suitable for life; f_l = the fraction of the ecologically suitable planets on which life might actually form; f_i = the fraction of the planets with intelligent life; f_c = the fraction of the planets with intelligent life that might communicate; and L = the lifespan of a planet with intelligent life.

According to Drake's calculations, there may be 10,000 civilizations in the Milky Way with whom we could communicate.

in something like this, where it's somewhat off the beaten path of mainline scientific research, it helped that there were educational and technological aspects along with important scientific and even philosophical questions."

All that was left was the politics. Tarter was in town when the Senate appropriations subcommittee met after the Machtley amendment passed in the House. "The thing happens at Gatling gun rate, and then it's all over," she says. "Everyone then crowds around Kevin [Kelly] to get their numbers. I went out to the hall and called a colleague and said, 'I just sat through this and have no idea what just happened.' When I went back in, Kevin saw me across the room and mouthed the words 'Full funding with language' to me. 'Full funding' I understood, but not the 'with language' stuff."

It was better than Tarter could have hoped for: the Senate appropriations subcommittee report would contain specific language directing NASA to spend every authorized penny on the Microwave Observing Project. In other words, no reshuffling the dough, as is often done in federal agencies. "It really wasn't until a day or two later that we fully understood what it all meant," says Pierson. "When we did, everyone on the SETI team was jumping up and down."

Last spring you-know-who came back to haunt Tarter once again, when Congressman John Duncan introduced another amendment to kill the search for—that's right—little green men. The amendment passed but NASA is still gearing up for the Microwave Observing Project in the optimistic belief that the Senate will restore funding.

> "If extraterrestrial beings exist, why aren't they here already?" asked nuclear physicist Enrico Fermi.

When NASA turns on its SETI listening devices this October 12, the 500th anniversary of the day that Columbus set sail for America, it's worth remembering that Columbus had to go see Queen Isabella for funding. Jill Tarter knows how that feels. ✈

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"Gentlemen, I Give You the Whittle Engine"

How war made England choose between protecting its technology and defending its borders

by Daniel Ford

Muroc Dry Lake, in California's Mojave Desert, boasts a five-mile stretch of sand, hard as concrete and flat as a table. A pilot can put down anywhere on that vast expanse with nobody the wiser. Because of its virtues of size and secrecy, Muroc became the site of Edwards Air Force Base, favored landing field for the space shuttle and for such super-secret aircraft as the once-classified B-2 stealth bomber.

And at Muroc, half a century ago, Robert Stanley of Bell Aircraft taxied across the hardpan and took to the air in another secret craft, a trout-like fighter with a wide flat wing. He was airborne for half an hour at an altitude of 25 feet, an unremarkable flight compared to what North American P-51s and Republic P-47s had already achieved that year, 1942. Yet Stanley's October flight was epochal because his Bell XP-59A had no propeller. "What a strange feeling this seemingly giant bird gave us as it approached," recalled Ted Rogers, a civilian engineer from the General Electric company, which had supplied the P-59's engines. "There was dead silence as it passed directly overhead—then a low rum-

A young businessman in 1944, Frank Whittle contemplates a model of the invention that would revolutionize air travel.

COURTESY SKI FRANK WHITE

COURTESY SIR FRANK WHITTLE (1)

The British establishment was slow to back Whittle; Harold Roxbee Cox (center) was one of his first supporters.

bling roar like a blowtorch—and it was gone, leaving a smell of kerosene in the air."

The Jet Age had come to North America; more specifically, it had been imported to North America. The P-59 was an American product, but its engines were designed in England by a Royal Air Force officer named Frank Whittle.

I was a schoolboy when the P-59 took flight, though of course I knew nothing about it until World War II was nearly won. What I did know, because it was drilled into me in geography class and reinforced by great washes of pink on every globe and atlas, was that the sun never set on the British Empire—an illusion that was not confined to American schoolchildren. In Britain, imperial pride helped lull government ministers, finally prodded into paying for the development of the turbojet, into handing the engine over to the United States without any apprehension about the competition they were creating for their own aircraft industry. Nor did GE realize that it had received technology that would turn a stodgy vendor of light bulbs and steam generators into the world's preeminent builder of aircraft engines. Ted Rogers would live to see his company's turbojets powering most of the world's air traffic—a tale of unintended consequences that began with one man's struggle.

The Proving Ground

In retrospect, what is most astonishing about the turbojet is how early it came on the scene. By the 1920s, inventors in Britain, France, Switzerland, and the United States were all trying to replace the Wright brothers' propeller with a plume of hot air. Among them was Pilot Officer Frank Whittle, who in 1929 sketched a piston-driven compressor that would inject fuel and air into a firebox, where it would burn, expand, and be vented out the rear. For every action there is an equal and opposite reaction, so as the exhaust rushed out at the back, the aircraft would move forward. The jet's efficiency would increase with altitude, and there would also be a ram effect, meaning that the faster the jet flew, the faster it would be able to fly—500 mph, Whittle thought, at a time when his own frontline fighter was rated at 150 mph.

Whittle abandoned the piston-jet hybrid when he calculated that it would weigh as much as a conventional engine, deliver no additional thrust, and burn more fuel. Then "the penny dropped," as he later said. "I suddenly thought, *Why not substitute a turbine for the piston engine?*" He took this plan to the Air Ministry Laboratory in London, where a respected government scientist, Alan Griffith (known as "Soap Bubble" for his use of a soapy film to measure stress in metals), was working on a gas turbine engine that would drive a conventional propeller. Whittle was 22.

In a piston, or reciprocating, engine, the piston compresses the air in a chamber for combustion, then on its rebound converts the combustion energy into mechanical energy to drive a propeller. Griffith's gas turbine, a refinement of industrial engines that had been around since the turn of the century, substituted a wheel, or turbine, to transmit energy to the propeller and to turn a rotary compressor. When Griffith reviewed Whittle's proposal, his own experience convinced him that the performance required of the turbine and compressor was unattainable. He demonstrated his skepticism by finding an error in the young man's calculations. Thank you, PO Whittle, and goodbye.

For seven years Whittle struggled with the turbojet without financial help from his government (all the while working with an RAF scholarship toward his baccalaureate degree from Cambridge University). During that period he managed to find backers for a prototype "Whittle Unit" to be assembled from parts supplied by the British Thomson-Houston company (BTH) in Rugby, and he put together his own small company, Power Jets Limited. In 1937 the Air Ministry finally chipped in with a tiny contract, mainly through the

Built by the Gloster Aircraft Company, the Pioneer had a single mission: to test the first British jet engine.

In 1938 Whittle changed his design from a single combustion chamber to 10 and tested the engine at the Ladywood Works.

Test pilot Gerry Sayer took the Pioneer on its first flight on May 15, 1941.

efforts of one scientist named Henry Tizard, the chairman of a scientific research group at the ministry. Tizard by most accounts was a clear thinker who formed his opinions without regard for politics and consequently held little political sway. He pronounced the turbojet "streets ahead" of any other proposal he had seen.

But this was an era of peace, as everybody believed except an out-of-favor politician named Winston Churchill, and it was another year before Tizard's committee came up with the promised £5,000 ($25,000). By the time the Whittle Unit screeched to life in March 1939, German troops were occupying Austria and part of Czechoslovakia. That year, nine years after it might have acted, the Air Ministry gave Whittle's company a contract to build an engine, the W-1, to power an experimental airplane from the Gloster company. Then Germany invaded Poland, Britain decided to honor its treaty obligations, and the world faced the terrible knowledge that once again Europe was about to be ruined by war.

"That is when I became acquainted with Whittle and his work," says Lord Kings Norton, a puckish 90-year-old who, when I spoke to him last spring at Chipping Campden, was outfitted with a cane, a blue blazer, and a tie with a motif of hot-air balloons. In September 1939 he was a government scientist named Harold Roxbee Cox, assigned to the development of civil aircraft. At the outbreak of hostilities, Rox-

bee Cox reported to the Royal Aircraft Establishment at Harrogate, where Air Vice Marshal Arthur Tedder put him in charge of engine development. "He was a very astonishing man," Kings Norton says of Whittle. "He came from a humble family in Coventry, and he was a 'boy' [apprentice] in the Royal Air Force.... They turned this boy into a damned fine officer who could have done anything, had he chosen to apply his intelligence to a [military] career.... He would have been an air chief marshal, no doubt about it. But he was absorbed in his invention."

Whittle was given the use of an old BTH foundry near Rugby, the Ladywood Works—"drab, pinch-penny, and sometimes frightening," as he described it. There he and a handful of engineers set to work building his design. A big piston engine like the Rolls-Royce Merlin did its best work at 2,000 revolutions per minute, but Whittle's W-1 would turn at 17,750 rpm, when its compressor blades would go supersonic and

COURTESY SIR FRANK WHITTLE

Knowing that Rolls-Royce and others were following their lead, the team at Power Jets could toast the future in 1944.

its firebox temperature would exceed anything then known to metallurgy. The Ladywood Works was impregnated with foundry sand, which fell from crevices in the roof like English rain during engine run-ups. It occasionally got into the engine, destroying parts machined to exquisite tolerances. Whittle developed an explosive temper; he suffered from eczema, boils, insomnia, and heart palpitations; his weight dropped to 126 pounds; and he looked decades older than his 33 years. To drive himself through 16-hour workdays, he sniffed Benzedrine from a nasal inhaler. Then he took tranquilizers and sleeping pills so he could sleep through the night and rise next morning and start again.

In the spring of 1940, Germany overran Norway, Holland, Belgium, and France. Britain's response was to bring Winston Churchill out of political exile. In one of his first acts as prime minister, Churchill created a Ministry of Aircraft Production and put it in the hands of a close friend and advisor, the newspaper baron Lord Beaverbrook. In the fall, the Germans came at England by air.

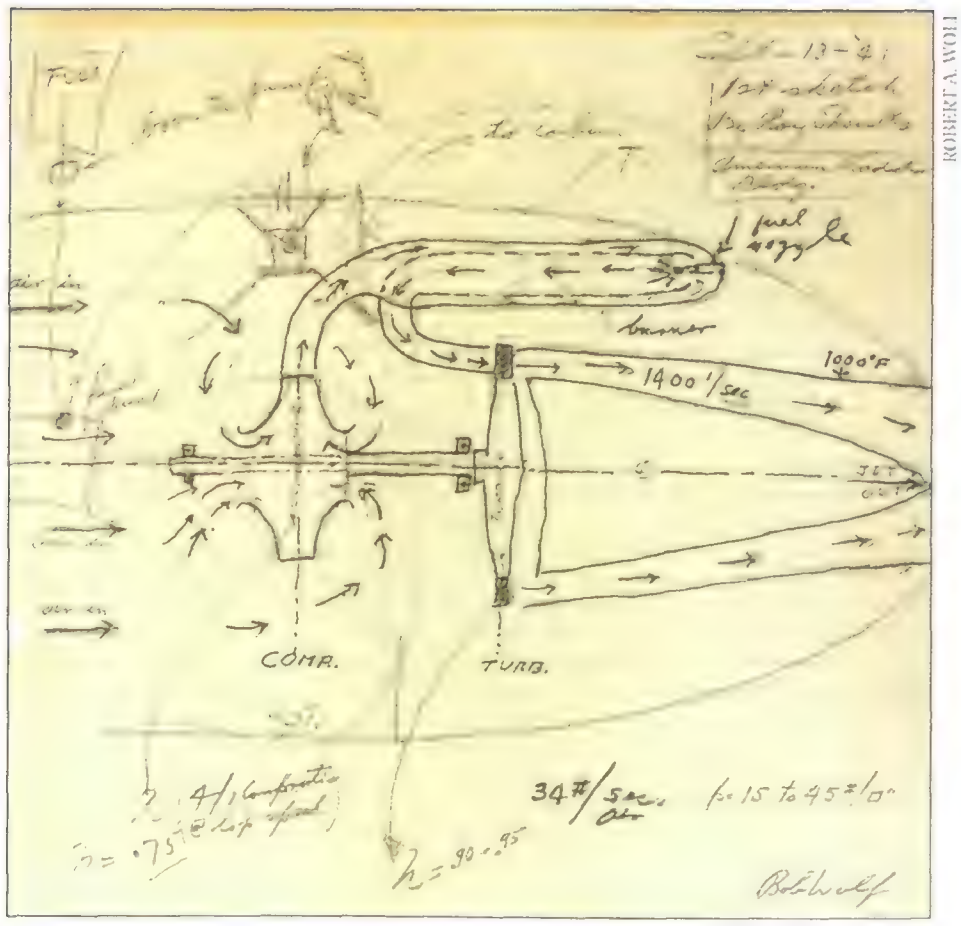
It is easy to believe, remembering how the Hawker Hurricane and the Vickers-Supermarine Spitfire fought the Battle of Britain, that Beaverbrook had an easy job. Yet the triumph of these fighters and their powerplant—the Merlin engine, which increased its power output by 100 percent between 1940 and 1945 and transformed the American P-51 Mustang into a legend—belied an anemic air industry that relied almost wholly on foreign suppliers for sophisticated machine tools. Beaverbrook, panicked by the desperate need for Spitfire fighters that could defend Britain *right now,* removed the priority order for the Whittle engine.

"Beaverbrook was a difficult chap," recalls Lord Kings Norton, whom the new minister inherited from the Air Ministry along with the turbojet. "He did some very stupid things. He tore up all the [household] railings...and he encouraged women to give up their iron saucepans." (As Kings Norton tells the story, the women took advantage of the scrap drive to upgrade their kitchens with aluminum pans.) "Nevertheless, he was not unlikeable. I was a relatively young man at the time, and I remember that when I was leaving his office he always insisted on helping me on with my overcoat."

Beaverbrook also inherited Henry Tizard as his scientific advisor. From this vantage Tizard pushed two schemes that the minister would otherwise have rejected out of hand. One of these stemmed from Tizard's belief in sharing technology with the U.S. allies and would lay the groundwork for the turbojet's eventual trip to the United States. But the first was to once again divert resources to the Whittle-Gloster turbojet contract. "Tizard was on the right side of this," Lord Kings Norton agrees. "He supported Whittle, no doubt about that." Tizard, Roxbee Cox, and Air Vice Marshal Tedder believed in Whittle's invention, though they were reluctant (Tedder especially) to share their enthusiasm with Beaverbrook. "Tedder was anxious that he never hear about it until it was further advanced [for fear that] Beaverbrook, whose eye was on doing things quickly and getting a lot of things made on the double, would stop the longer-term project," recalls Kings Norton. "Nevertheless, Beaverbrook did hear about it; he did send for me, I did talk to him, and I brought Whittle to meet him. And of course he took to Whittle."

Still, there were obstacles. "There were people who believed we should stick to the old-fashioned piston engine, and this newfangled thing wouldn't work," Kings Norton recalls. There were doubts about the inventor too, or at least about his ability to manage an industrial enterprise—doubts possibly based on Whittle's youth and management style. "Tedder didn't feel that engine production should be in Whittle's hands, and there he was wrong, in my view," says Kings Norton. In one of the most boneheaded decisions of World War II, the Air Ministry picked the Rover company to build the W-2 turbojet which would power a twin-jet Gloster fighter, the Meteor. An automobile manufacturer, Rover's only experience in aircraft engines came from operating a "shadow factory," a surrogate that would take over if another manufacturer were bombed out.

"I can't remember whose idea it was," Kings Norton says, "but Rover's did come in and were presented with the Whit-



ROBERT A. WOLF

Roy Shoults' sketch of Whittle's engine helped explain the concept to the designers at Bell Aircraft in September 1941.

Five GE engineers were among the few to witness the XP-59A's historic flight on October 1, 1942.

tle engine, but in their own wisdom, and very much against Whittle's own ideas, they wanted to make changes in the design. They may conceivably have been improvements, but they had to be tested, and Whittle saw this as more and more delay."

In the end, an airworthy W-1 was not ready in time for Gloster to run taxiing tests on its Pioneer airframe. So Whittle assembled a "lash-up" from a spare rotor, some rejected parts, and bits of his prototype. The W-1X (the final letter indicated that it wasn't safe to fly) was trucked to western England so Gloster could proceed.

On April 7, 1941, Flight Lieutenant Gerry Sayer taxied onto the Hucclecote airstrip and ran the W-1X up to 13,000 rpm, at which point the Pioneer rolled across the grass at 20 mph. Next morning, Whittle himself took the controls for a run-up to 15,000 rpm and 60 mph. After lunch he agreed that Sayer could push the engine briefly to 16,000 rpm. He did, and the Pioneer lifted off the grass and flew 200 yards before touching down.

Yankee Traders

When England declared war, Henry Tizard realized that his country did not have the industrial strength to hold off Germany, and he was one of the first to propose sharing technical information with the United States. His was a lonely voice in 1939, but by the summer of 1940 Britain had spent its last dollar buying American airplanes and engines to supplement its own production, leaving it with no other currency

than its great lead in military technology.

The notion of swapping information for materiel outraged Beaverbrook, born in Canada and congenitally wary of Yankee traders. And when Tizard was finally put in charge of a technology exchange mission to Washington, Beaverbrook lectured Churchill before Tizard left, "My view is: give no secrets to Americans, except for money value received." And when Tizard returned, Beaverbrook grumbled, "The American government...is asking for the moon and appears unwilling to pay sixpence."

The mission did give the Americans more than it got, including key radar technology, but it held back on jet propulsion. "The interesting parts of the subject were apparently not known to Tizard," Vannevar Bush of the National Advisory Committee for Aeronautics later complained to the U.S. Army Air Forces. For the moment, Beaverbrook's warnings must have held. Tizard knew a great deal about the Whittle engine, certainly enough to have steered NACA engineers away from their pursuit of a piston-jet hybrid like the one Whittle had considered and rejected in 1929.

Not relying on official channels, U.S. military intelligence had been filing reports about jet propulsion projects in Britain, Germany, and Italy. When these reached Major General Harold (Hap) Arnold early in 1941, the air forces chief thought they referred to rockets or to takeoff boosters like those under development in this country. When he realized that the Europeans were on to something more radical, Arnold decided to visit Britain and have a look at this and other advances in military technology. Happily for him, Beaverbrook had by this time become a believer in technology exchange.

"We would even allow him to see the Whittle engine, which has just made its first jumps," he wrote in a memo on April 11, the day Arnold reached Europe (the memo was probably meant for Churchill). "We have not shown it to a soul yet. Indeed we have even flown it on a cloudy day so that the angels could not see it. But what is forbidden to the angels shall be permitted to the General."

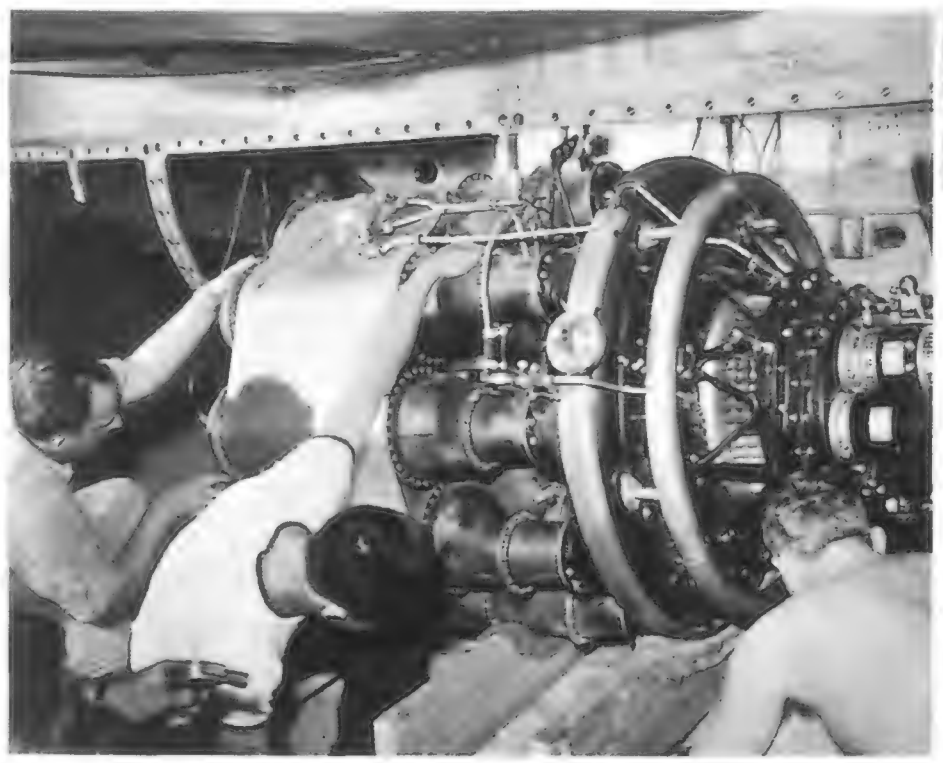
Beaverbrook's newfound amiability had been prompted by the Lend-Lease Act just passed by the U.S. Congress, giving Britain a $4.7 billion draft on American industry (on the genial fiction that it would all be returned when the war was over). This astonishing piece of generosity ensured that Hap Arnold would be welcomed to country-house evenings with Beaverbrook and Churchill, given an audience with King George VI, and briefed by Henry Tizard, who alerted him to the likelihood that an entire generation of airplanes and engines "might be thrown on the scrap pile" as a result of British progress in jet propulsion.

Hap Arnold had never flown a combat mission, was not a natural pilot, and was too short-tempered to be a good executive. But he had three great assets: a West Point ring, a knack for impressing superiors, and a genius for logistics, which he now put to work on behalf of the turbojet. Back in Washington on May 1, he told Vannevar Bush to have somebody evaluate the Whittle engine. The job fell to Roy Shoults, a General Electric engineer already in Britain, helping modify the superchargers on the B-17 Flying Fortress.

As it happened, the supercharger refit was done at the BTH factory, which was building parts for the W-1 and de-

JET PROPULSION LABS ASSOC.

The two Type I-A turbojets on the XP-59A were run through three five-minute thrust tests before the taxi runs.



GENERAL ELECTRIC

veloping its own version of the W-2. "As I went about my turbo-supercharger work," recalled Shoults, a bald, beefy man with a head resembling a .45-caliber bullet, "I was gradually made aware of the details of the Whittle engine." Among other things, he must have heard that the Gloster Pioneer had made its first flight on May 15 at Cranwell.

In its blithe neglect of innovation, the RAF did not send a camera crew to Cranwell. However, I recently viewed at the National Air and Space Museum in Washington, D.C., an amateur film of the event. On its tricycle landing gear, the airplane had the stubby, plump-breasted look of a game bird, running along the ground, trying to gain enough speed to take off. We also have a memorable description by a laborer who was "concreting the runways" that morning: "I see an aeroplane come out the hangar without a propeller. It came right closer to us and turned into the wind and run down the ground like a partridge and took off into the air and circled around, whistling around, all around, and disappeared into the clouds." Before the trials were concluded,

BOEING HENDERSON/USAF

Bell and GE crews checked the engine installation carefully after the aircraft crossed the country by train (left, below). The second airplane had to be moved to another airfield for tests. To keep its powerplant a secret, engineers attached a fake propeller to the XP-59A before towing it (above).

Pioneer flew at 370 mph—faster than the Merlin-equipped Spitfire that was its chase plane—while the W-1 delivered a thrust of 850 pounds.

At the end of May, Arnold put in a formal request for the turbojet technology. By now, Beaverbrook had been replaced by Colonel John Moore-Brabazon, who responded to the request with a grudging nine-paragraph memo, typed on blue note paper with "Secret" scrawled across the top in red pencil. "The Whittle jet propulsion engine," the new minister wrote, "consists of 10 combustion chambers (equivalent to the cylinders of a normal engine), an exhaust gas turbine, a supercharger, and an exhaust jet or nozzle." Arnold forwarded this rather unhelpful description to Vannevar Bush at the NACA.

Then Curtiss-Wright blundered into the negotiations, asking for a license to build the engine in the United States. Like Roy Shoults, the company had heard about the turbojet through routine gossip, but the British decided that giving secrets to the Americans was like publishing them in the *Times*. For his part, Arnold thought that the British were responsible for the leak, and weeks were lost while the damage was assessed, blame passed around, and feathers smoothed. Finally, on July 15, Moore-Brabazon cabled the British Air Commission in Washington that "we agree to release of information on the Whittle [engine] to U.S. government, subject to special care being taken to safeguard its secrecy." As to who should build it, he suggested General Electric, whose superchargers he greatly admired.

And so the decision to give America the jet was made apparently without apprehension about sharing the future of aviation with the awakening giant across the sea. Kings Norton believes that the minister made the decision gladly: "We really *asked* your country to come into it," he says, "because we wanted that vast production capacity behind the manufacture."

Frank Whittle—Sir Frank now—agrees. I recently visited his condominium apartment in Annapolis, Maryland, with the happy address of Windstream Drive. I found a stocky, rosy-cheeked man in a polo shirt, surrounded by mementos of the turbojet. I asked if anyone was worried about handing his engine to GE. "Oh, I don't think so," he said. "As I understand it, the U.S. government gave an undertaking that the information gained would be used only for war purposes." Indeed, Sir Frank recalled, he *wanted* a shadow factory to build the turbojet in North America. (He expected, however, that the work would be done in Canada, one of those washes of Empire pink on the pre-war globe.)

Nor is there any hint in British archives of a debate on the gift of the turbojet. And after all, why should there have been? Quite apart from the fact that it was engaged in a war it could not win without American participation, Britain had dominated world trade for centuries, and great powers generally have the most to gain from the free flow of goods and information. In the summer of 1941, not even Winston Churchill really understood that the world's center of gravity had shifted 3,000 miles west.

At 10:30 a.m. on July 21, Roxbee Cox briefed Roy Shoults of GE and Colonel Alfred Lyon of the American Embassy. He then took the two Americans to the Ladywood Works and the Gloster factory. Though they were not entirely sure what they had seen and heard there, they recommended on August 16 that a crash program be undertaken to mass-produce the British turbojet in the United States, and Shoults flew home to brief Hap Arnold in person.

Arnold agreed with the British that GE was "a most suit-

able firm" to build an American turbojet, so he sent Shoults to Boston to brief his superiors at the River Works supercharger plant in nearby Lynn. At the same time, Arnold sent an air force officer to London for an expert evaluation of the turbojet. Donald Keirn, a lanky, jug-eared major with a fighter pilot mustache and a background in engine research, took the train to Rugby on August 28, inspected the Ladywood Works, and spent four days picking Whittle's brain.

A GE delegation went to Washington on September 4. As the story is told, Arnold turned to a small safe in his office, twirled the combination lock, took out a sheaf of drawings, and handed them over. "Gentlemen," he is supposed to have said, "I give you the Whittle engine." Talk about the strangeness of war! Here was a two-star general, dispensing what was arguably the most important commercial advantage of the 20th century.

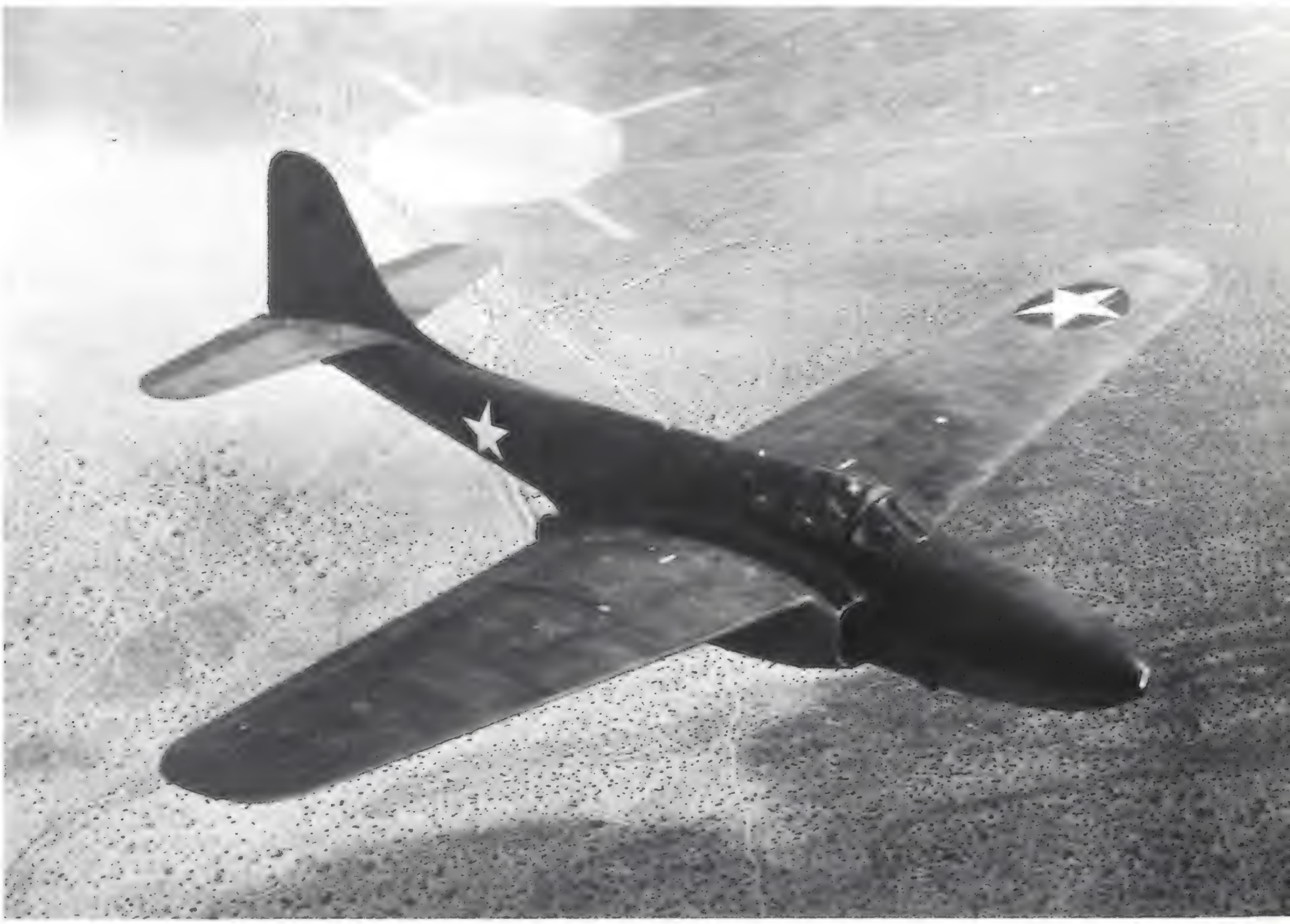
Exactly what Arnold handed over is a mystery. Moore-Brabazon's memo, no doubt, and probably notes and sketches from Don Keirn, Al Lyon, and Roy Shoults, but not the production drawings that would have enabled GE to set to work. No matter. GE promised to build a working turbojet within six months, with 15 production models to follow. Next day, another delegation, this one from Bell aircraft, appeared, promising to supply three prototype jet fighters. Arnold meant to skip the testing of the engine in an experimental airframe—the time-consuming process that the British had followed with the Gloster Pioneer.

The Fast Track

Arnold cabled Moore-Brabazon that the United States was ready to clone the turbojet. Would the Ministry of Aircraft Production please provide a sample engine, an airframe, and some knowledgeable engineers, along with formal authorization to proceed? On September 22, the head of the British Air Commission obliged—with conditions, of course, the most important being: "As the information and drawings have been released...and permission to manufacture has been given, in order to assist the joint defence plans of our

In 1941 Major General Harold (Hap) Arnold set in motion the plan to import the jet engine from London.

Although the XP-59A attained 413 mph at 30,000 feet in test flights, it was too unstable for combat.



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respective Governments, it is agreed that its use will be limited to such purpose." In other words, the turbojet would be used for combat aircraft, not for powering passenger and freight planes when the war was over. To drive this point home, the letter concluded with the lawyerly phrase "commercial rights relating to the apparatus and information now in question being hereby reserved." (Apparently, Americans were not the only ones susceptible to genial fictions.)

In London, Don Keirn was told to go to the Ladywood Works and take delivery of a turbojet. Symbolic of Britain's meager production, what he got was the lash-up that had powered the Pioneer on its taxiing hop. Accompanied by Keirn and three British technicians, the W-1X was trucked to Prestwick and loaded into the bomb bay of a Consolidated B-24 Liberator. The four-engine bomber took off on October 1 and landed the next day at Bolling Field in Washington, where U.S. customs agents demanded a look at the cargo. After two days of argument, they agreed to merely count the crates—three—rather than inspect them, and the party flew on to Boston. As GE reconstructs the handover, it involved a B-17, a civilian guard with a rifle, and a panel truck with the company name painted out. The W-1X was taken by a roundabout route to the sprawling redbrick River Works plant and unloaded at Building 34 North.

At great pains to keep their work secret, GE technicians constructed a special test cell for the engine deep in the interior of the building and vented it into a six-story chimney. No one spoke of the project.

Outside Boston on October 16, the British team fired up the W-1X, and for the first time the wail of a turbojet was heard on the North American continent. "Until we pushed the button and showed this thing running," said Daniel Walker, a technician from Whittle's company, "the Americans wouldn't believe it would work." The W-1X now belongs to the National Air and Space Museum. It is not much larger than a four-cylinder Honda engine, and it looks as though it were made of tin cans—or saucepans from Lord Beaverbrook's scrap drive.

GE then set out to build a W-2, guided by the W-1X and an incomplete set of drawings supplied by Rover. "We made some modifications to [the British design]," says Jerry Henderson, one of the American engineers, "but basically it was a copy." Another GE employee, Floyd Heglund, recalls that "the biggest single difference was the gear train and the drive for the accessories, [but] the first version of the engine was really pretty much taking the British design and building it." GE even followed the British practice of calling the engine a supercharger. The deception extended to such long-time employees as Jerry Henderson's father, who spent the winter of 1941-1942 machining parts for what he thought was GE's eighth supercharger, the Type I.

The engine ran briefly on March 18 and reached full speed a month later. Soon it was developing 1,250 pounds of thrust. That was less than the W-2s being tested by Whittle, BTH, and Rover, but the GE engine performed more consistently. Whittle came to Boston and helped solve a problem with bearings burning, the result of a missing oil passage that Rover draftsmen had apparently omitted from the drawings sent to America. For its part, GE suggested a new alloy and a more robust design for the compressor blades. Living at a Boston hotel, the haggard, sometimes forgetful wing commander was astounded to hear the Americans talking of a $60 million factory to produce 1,000 engines a month. (In fact, the United States would not build as many as 1,000 turbojets by the time the war ended.)

Germany's Me 262 was the world's first operational jet fighter. The first jet, the 1939 He 178, was also German.

In August, GE delivered two engines to the Bell factory in Buffalo, New York. They were installed in the first P-59, which was then sent to California in a boxcar, accompanied by three GE engineers and six armed guards. The maiden flight was planned for October 2, but the assembly and run-up went so quickly that test pilot Bob Stanley was making high-speed taxi runs by September 29. On one run the P-59 lifted three feet off the hardpan, whereupon Stanley offered to take it up then and there. Larry Bell said no, and the next day was spent rewiring the port engine.

And so it was one year to the day after the lash-up left Prestwick that Stanley made his historic flight. The Bell P-59 took off from Muroc a few minutes after noon on October 1, 1942, trailing a plume of smog-brown smoke. It was

a sweet moment for the Americans. In 12 months, from a standing start, they had beaten the British at their own game.

But they had not beaten the Germans. On July 18, Messerschmitt had tested a twin-jet fighter that would be the most formidable interceptor of World War II. Happily for the Allies, the Me 262 was modified into an attack bomber, thus delaying its combat debut until the end of the war in Europe.

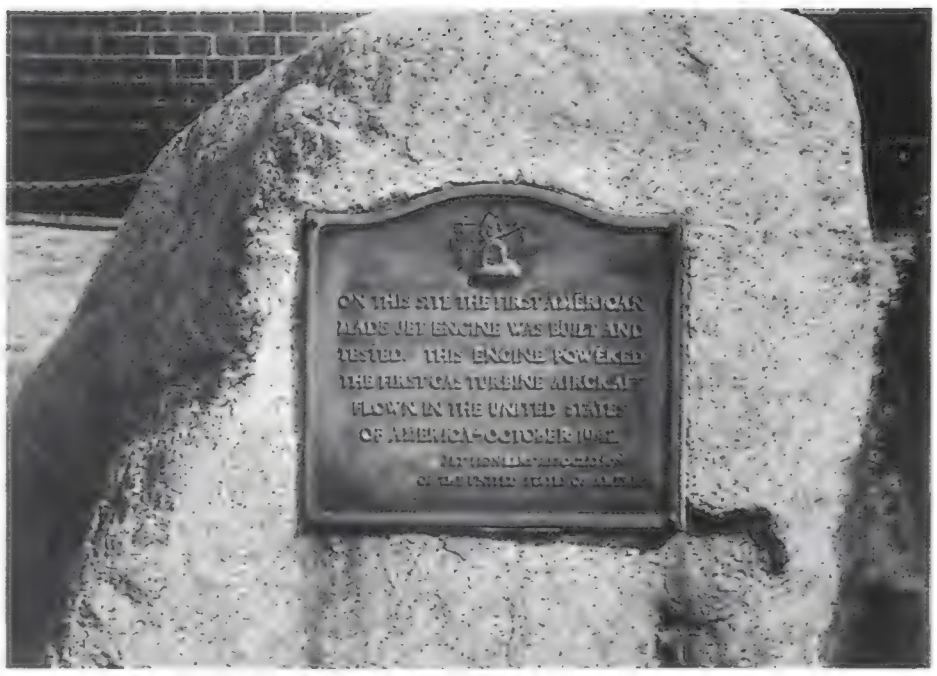
Reversals of Fortune

In England, the Rover Company had yet to produce its first engine. On the day after Whittle's W-1X arrived at Bolling Field, Roxbee Cox convened the first meeting of the Gas Turbine Collaboration Committee, whose members he drew from the various turbojet ventures that had appeared in engine companies since Whittle started Power Jets. "It was obvious that we'd got to get the support of the aircraft engine industry," he explains today, "and we brought in BTH, Rolls-Royce, Metropolitan Vickers, Armstrong Siddeley, [and] Bristol, and I told them...that any ideas they got must be given to all the others, and that their protection would be a provisional patent. And that's what happened."

With the committee for cover, the Ministry of Aircraft Production fired Rover as prime supplier of turbojets for the Gloster Meteor and brought in Rolls-Royce. Seven months after the Me 262, and five months after the P-59, the Meteor finally got off the ground in March 1943. But the RAF regarded it as a pure interceptor, and it did not see aerial combat before the war ended. (Neither did the P-59. Overweight and unstable—a disabling flaw in a fighter—it finally went into service as a jet trainer.) "It could be said that the jet engine did not have a great influence upon the course of the war," Kings Norton concedes. "The major developments came afterward. But at least the Meteor did fly for the Royal Air Force, and did do quite a lot of work bringing down missiles [V-1 buzz bombs]."

When the war ended, the British realized that there was no way to put the turbojet genie back in the bottle and accepted $4 million in payment for America's past and future use of Whittle's patents. The Army Air Forces bestowed the gift of the turbojet on both the Allison Division of General Motors and Wright Aeronautical, much to the dismay of the managers at General Electric. The air service also provided expert technical assistance in the persons of Hans von Ohain, the inventor of the first German turbojet, and Anselm Franz, the designer of the Jumo 004 engine for the Me 262. Franz and von Ohain were among the German scientists and engineers the U.S. military brought to the research division at Wright-Patterson Air Force Base after the war.

Having been handed the jet, U.S. companies at first didn't know what to do with it. Engine and airframe manufacturers doubted its applicability to commercial air travel. Yes, it could offer speed, but not the other requirements of the airlines: efficiency and reliability. In 1947, William Littlewood, the director of research for United Aircraft, told the NACA that his company had decided, after considerable study, that the jet engine had no future for commercial applications. It took another 10 years to mature the technology and reverse that opinion.



GENERAL ELECTRIC

A group of Bell and GE employees placed this monument at the site of the engine plant in Lynn, Massachusetts.

Again, England was the pioneer. It was the Rolls-Royce Avon that successfully powered the first commercial airliner, the de Havilland Comet. The British de Havilland company lost the commercial airliner market to the U.S. competitors Boeing and Douglas after two Comets crashed in the Mediterranean in 1954. Only then did Pratt & Whitney and General Electric rise to dominance.

The Inventor

When the Ministry of Aircraft Production handed the contract for the W-2 to Rolls-Royce, Wing Commander Whittle lost control of his invention. "In the end," Kings Norton concludes, "the influence of the industry was such that Whittle's own company...was told that it could no longer design engines." Worse, the company was nationalized as a government research institute, depriving Whittle of any say in how his invention would be exploited. A bitter man, he quit the RAF and eventually the country.

"In 1946," Kings Norton says, "I had a letter from the Royal Commission on Awards to Inventors asking me, at that late date, to give an assessment of the value of Whittle's work. And I wrote the most influential letter I have ever composed in my life. I said: 'Whittle's place in the annals of engineering history comes after those of Stevenson and Watt and Parsons only for reasons of chronology or alphabetical order.' Because of that...they doubled the award to £100,000 [$400,000]. So he didn't do badly, financially, in the end.

"Engineers all knew what he had done. He gave lectures here, he gave lectures in America, he had awards of all kinds, but even the air force didn't take him beyond air commodore [equivalent to a U.S. brigadier general]. But in the end—it was only about five years ago—the Queen gave him the Order of Merit, the highest honor this country can bestow. So in the end the recognition was complete."

By that time Frank Whittle too had long since moved to the United States. ✈

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Waiting for Someone to Blink

Eyeball to Eyeball: The Inside Story of the Cuban Missile Crisis *by Dino A. Brugioni. Random House, 1992. 622 pp., b&w photos, $35.00 (hardbound).*

The collapse of the Soviet Union has exorcised the specter that haunted humankind for more than 40 years: the prospect of global nuclear war. With the cold war likewise fading into history, it is becoming increasingly difficult to recapture, especially for a younger generation, the feeling of measureless doom that used to accompany phrases like "strategic alert," "nuclear exchange," and "worst-case scenario." While it is, perhaps fortunately, impossible to recreate the almost electric atmosphere of tension that prevailed during the 1962 Cuban missile crisis—a tension that caused several fellow students at my high school to burst into tears upon hearing the public address system come to life on the tensest day of the crisis—Dino Brugioni, a former photo analyst for the Central Intelligence Agency, comes close.

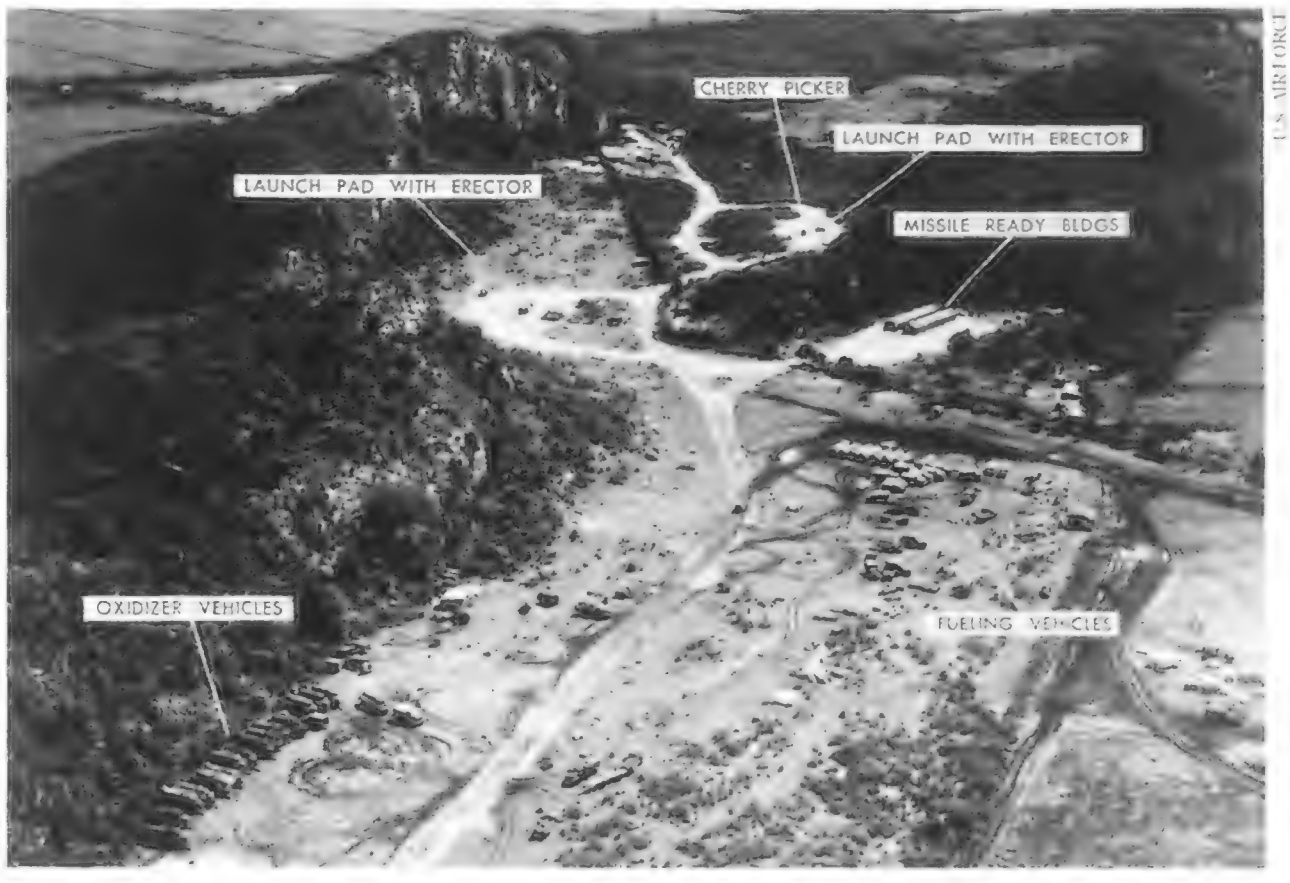
Those readers of *Eyeball to Eyeball* who were alive during the crisis will probably be surprised to discover how fresh and vivid are the 30-year-old memories awakened by the book; those too young to remember will doubtless be amazed to discover that the superpowers nearly annihilated each other in a dispute over a handful of glorified nuclear-armed Scuds on a Caribbean island.

Not surprisingly, the book is strongest when Brugioni tells the story he knows best: the crucial role of the intelligence that was gained through photo analysis. Pictures taken by high-flying U-2s originally revealed the Soviet missiles in Cuba; low-flying photo-reconnaissance aircraft closely monitored the construction of the missile bases and then their hurried dismantling after the Soviets capitulated. (One of the U-2s used over Cuba, along with its camera and related gear, can be seen today in the Looking at Earth gallery of the National Air and Space Museum.)

Laymen—including President John Kennedy, his brother and advisor Robert, and the U.S. ambassador to the United Nations, Adlai Stevenson—remained almost totally dependent throughout the crisis on the judgment of skilled photo analysts at the National Photographic Interpretation Center, since they were themselves unable to recognize as missiles the tiny shapes that appeared on literally miles of film. The hero of Brugioni's tale is his former boss, Arthur Lundahl, head of NPIC at the time of the crisis and the man who personally briefed the Kennedy brothers and Stevenson on the meaning of the historic photos. The villains—besides the Soviets, of course—are the state department, whose hand-wringing objections to the overflights denied coverage of Cuba during a crucial two weeks leading up to the crisis, and the Air Force, whose parochial insistence upon playing a larger role was at least partly responsible, Brugioni implies, for the single American fatality of the crisis, an Air Force U-2 pilot shot down over Cuba.

As a "Company" man, of course, Brugioni tells a tale that is itself not entirely devoid of parochialism. The book gives an almost gleeful account of the Strategic Air Command's misguided and ultimately unsuccessful attempt to grab some of the CIA's glory by dispatching a flight of SAC aircraft on what turns out to be a wild-goose chase for Soviet ships thought to be carrying missiles. When a SAC photo interpreter misidentifies a fallen palm tree as a Soviet rocket the suppressed hilarity of CIA analysts at NPIC isn't difficult to imagine.

Eyeball to Eyeball is less successful, and less compelling, the farther it wanders from the events the author participated in or at least knew something about. Curiously, Brugioni makes little use of new details on the crisis that emerged from a series of five conferences, held between 1987 and January 1992, for American, Soviet, and Cuban participants. The most dramatic revelation to come out of these meetings—the Soviets' disclosure that not only were there 36 nuclear warheads in Cuba at the time of the crisis, but the local Soviet commander



U.S. AIR FORCE

Revisiting Armageddon

When he retired from the CIA in 1982 after 34 years as a photo analyst, Dino Brugioni set out to write an account of the Cuban missile crisis. Working out of his home in Hartwood, Virginia, about an hour outside of Washington, Brugioni spent nearly 10 years writing *Eyeball to Eyeball*—perhaps, he jokes, because he did his best editing only while watching Monday Night Football. For his research he relied primarily on the briefing notes that he wrote for the director of the National Photographic Interpretation Center, Arthur Lundahl, who used them to update the president and his advisors.

Brugioni has nothing but praise for the president's handling of the 1962 crisis, describing it as "Kennedy's finest hour." He recalls that the tensest day of the crisis was October 27. That morning he told Lundahl that 24 missile sites were operational, meaning that the Russians could fire a missile at the United States six hours after a command was given. Later that day a U-2 was shot down. "I really thought, as I indicate in the book, that it was Armageddon," says Brugioni. He called his wife and told her that if he called again it would be to tell her to get in the car with the children and drive to his parents' house in Missouri. "I was sure Washington would be a target," he says.

Brugioni is now at work on a book about computer manipulation of photography.

had been given authority to use nine of them against an American invasion of the island—apparently came to light after the book had gone to the printers. Learning of this fact last January, Robert McNamara, Kennedy's secretary of defense, calculated that "there was a 99 percent probability that nuclear war would have been initiated" had the Soviets not agreed to remove the missiles from Cuba.

In retrospect, it's clear that those anxious high school students had good reason to cry.

—Gregg Herken is chairman of the department of space history at the National Air and Space Museum and author of Cardinal Choices: Presidential Science Advising From the Atomic Bomb to SDI *(Oxford University Press, 1992).*

SIEVE ST. MARTIN PHOTO COLLECTION

Lafayette Escadrille: Pilot Biographies
by Dennis Gordon. The Doughboy Historical Society, 1991. 271 pp., b&w photos, $19.50 (paperback).

In April 1916, seven young Americans, five of them scions of millionaires, formed the most famous pursuit squadron of World War I: the Lafayette Escadrille. French officials at first balked at the idea of an all-American squadron of volunteer pilots fighting for the French Republic, but when they saw the value of gaining wider American sympathy for their cause, they relented. Initially the squadron was called Escadrille Américaine, but when the German ambassador in Washington protested that the United States had not yet entered the war, the name was changed to Escadrille de Volontaires and later to L'Escadrille Lafayette, in honor of the famous Frenchman who fought with the Americans in the Revolutionary war.

As its title implies, this book offers detailed biographies of each of the squadron's 38 pilots, as well as several French officers and others who were involved with the squadron (including the mascots, two lions named Whiskey and Soda). They were a varied group: soldiers of fortune, adventurers, architects, engineers, students, playboys, polo players, aviators. Some were motivated to fight for France for idealistic reasons, others out of a sense of adventure. But any romantic notions they possessed early on would later be tempered by the loss of 11 fellow squadron members.

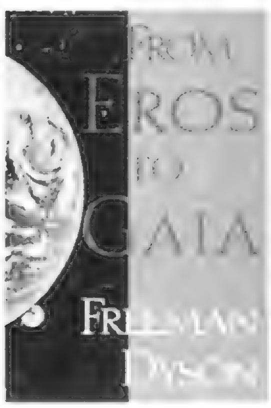
Dennis Gordon has produced a fine collection of individual stories, and his extensive research adds valuable human interest to the history of the Lafayette Escadrille. The book contains 223 photographs, many of which have never been published before, and my only complaint is that the photographs are not credited. I highly recommend this book for students of the first air war and look forward to more books from Dennis Gordon.

—Karl Stirling Schneide is acting collections manager in the aeronautics department of the National Air and Space Museum.

From Eros to Gaia *by Freeman Dyson. Pantheon, 1992. 345 pp., $25.00 (hardbound).*

This is a wonderful collage of 35 thought-provoking essays written by a physicist who has a knack for touching the essence of an issue in words we can all understand. Freeman Dyson, a professor at the Institute for Advanced Study in New Jersey (and a contributing editor to *Air & Space/Smithsonian*), has a marvelous imagination that takes us on a tour that ranges from the idiocy of political machinations to the view of the sky afforded by a mugging. Do not be put off by the title. There is little of Eros and less of Gaia. It is what lies between that will animate your neuronal activity.

Dyson calmly analyzes the growing superconducting supercollider funding fiasco by comparing it to parallel examples across cultures, and he offers hope that perhaps we may yet learn from experience. Bigger is not always better, and often not even necessary. "To do well in science," he predicts, "we must vigorously exploit new technologies that make our instruments smaller, cheaper, and smarter."



Dyson succeeds beautifully in describing field theory, both classical and quantum. His words will clarify the material for the uninitiated but might make the purists shudder. Nonetheless, many concepts in modern science can be communicated to us only if the experts bend the rules of rigor.

Other essays cover the perils of unfashionable pursuits, colleagues up close and personal, and the importance of being unpredictable. "My intention is not that my readers should believe everything I say," writes Dyson, "but that they should be provoked into forming their own judgments, their own vision of human needs and purposes." For those who like to have their thinking provoked, this potpourri of essays is an intoxicating mix. Dyson reminds us that if we wish to make a creative move, we should prepare to be misunderstood. "For any speculation that does not at first glance look crazy, there is no hope," he says.

There are so many opportunities to be human, Dyson suggests as he considers the survival of our planet in the light of our violent nature. Gaia, emerging symbol

of the living earth, is reeling from the blows we are delivering. To survive we will need to re-establish a bond with the earth. "Respect for Gaia is the beginning of wisdom," he concludes hopefully. But will we learn to bestow respect in time?

—Gerrit L. Verschuur is a contributing editor of Air & Space/Smithsonian.

Not at Your Local Newsstand

In addition to the many familiar publications available, other, less well known periodicals cover aviation and space.

"To create a spacefaring civilization which will establish communities beyond the Earth in our lifetime" reads the credo at the top of the masthead of the *Spacefaring Gazette*. Published by the Golden Gate Chapter of the National Space Society, this lively publication features lots of opinion pieces and irreverent humor. Subscriptions: $35 ($20 for seniors and students). *Spacefaring Gazette*, 4009 Everett Avenue, Oakland, CA 94602.

Airpower Journal, a handsome quarterly journal published by the U.S. Air Force, is an "open forum for presenting and stimulating innovative thinking on military doctrine, strategy, tactics, force structure, readiness, and other national defense matters." Subscriptions: $9.50. *Airpower Journal*, New Orders, Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250.

Airliners calls itself "the world's airline magazine." Colorful articles cover exotic locations and airlines around the world. Subscriptions: $15.95. *Airliners*, Circulation Manager, P.O. Box 52-1238, Miami, FL 33152.

The Boeing 247: The First Modern Airliner *by F. Robert van der Linden. University of Washington Press, 1991. 254 pp., b&w photos, $24.95 (hardbound).*

Its place in history has been eclipsed by the Douglas DC-3, but the Boeing 247 was there first: all-metal semi-monocoque fuselage and low, fully cantilevered, all-metal wing; retractable landing gear; trim tabs, autopilot, and wing de-icer boots;

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South Texas Birds February 13-20.

Baja Whale Watch February 25-March 3.

Virgin Islands Cruise February 27-March 5.

New Orleans/Natchez February 28-March 7.

New York: Potpourri of Arts March 4-7.

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Borneo and Indonesia Cruise October 27-November 15.

London Interlude October 29-November 7.

Hidden India October 29-November 22.

Columbus in the Caribbean November 4-14: Aboard the *Sea Cloud*.

Moscow and St. Petersburg November 8-17.

Christmas in Winchester (England) December 17-28.

City Interludes (January-April) Off-season tours of London, Paris, Prague, Tibet, Florence, Hong Kong, Venice, St. Petersburg, Edinburgh, Kyoto, and Vienna.

Yucatan Adventure January 5-17.

Tanzania January 5-24.

Baroque Winter (Austria) January 6-16.

Patagonian Andes (Chile and Argentina) January 9-22.

India Wildlife Safari January 17-February 11.

Oaxaca Countryside (Mexico) January 29-February 8.

Western Caribbean Cruise February 1-12.

Whale Watching in the Dominican Republic February 6-16.

Far East Adventure February 6-26: Singapore to Thailand.

The Island of Dominica February 10-18.

Lapland Reindeer Safari February 21-March 2.

Guatemala Adventure February 23-March 8.

Patagonia to Rio Cruise February 26-March 16.

Alpine Snow Train March 4-16.

Australia and New Zealand March 4-25.

From Singapore to India's Malabar Coast March 5-23.

Costa Rica March 14-26.

China-Japan Cruise March 15-April 2: Aboard the *Royal Viking Queen*.

Rio de Janeiro to Spain Cruise March 13-April 4: Aboard the *Illiria*.

Central Mexico Archaeology March 17-29.

North Africa Cruise April 1-16.

Dutch Waterways Cruise April 12-25.

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Blacks in Aviation (Washington, D.C.) February 3-6.

Southwest Culture and Cuisine (Santa Fe) February 21-25.

Wolves of the North Country (Minnesota) March 8-13: Track wolf packs.

Symbols of Faith in India and Nepal March 8-23.

Australia's Great Barrier Reef March 9-24.

Panama March 14-20: Study with scientists at the Smithsonian Tropical Research Institute.

Key West Literary Seminar (Key West, Florida) March 28-April 1.

Research Expeditions

Contribute your time, talent and financial resources to Smithsonian research. Work with curators at the Smithsonian or at field sites around the country and the world.

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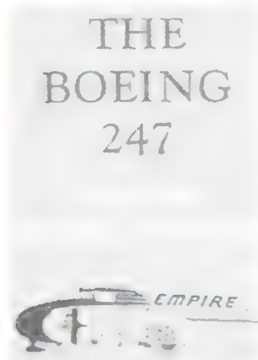
Curaçao, Netherlands Antilles March 6-21: Excavate remains of giant tortoises.

Washington, D.C. March 21-April 3: Help develop *Red, Hot and Blue*, a Smithsonian exhibition on American musical theater.

For brochures: Write or call Smithsonian Study Tours and Seminars, 1100 Jefferson Dr. S.W., Washington, DC 20560; (202) 357-4700.

and fully cowled, wing-mounted engines. F. Robert van der Linden's book explains how these innovations set the mold for subsequent commercial airliners, as well as how the 247 was overshadowed.



The early retirement of the first modern airliner was due in large part to engineering decisions that left Boeing on the fringe of the commercial airline market until the 707. The author points out that to shave weight, the designers of the 247 rejected bigger engines with more power and a variable-pitch propeller. Both features gave the Douglas twins single-engine performance that soon had budding transcontinental airlines knocking on the door in Santa Monica. Worse, the Boeing designers opted for a small airplane—passengers had to clamber over the wing spar carry-through in the cramped cabin—as cheaper to buy and operate and easier to fly. Those kinds of choices confront designers today, and the 247's story is valuable reading not only as an airplane biography but as a study of how corporate imperatives and technological mindsets can go wrong.

—*William H. Gregory is a former editor of* Aviation Week & Space Technology.

Fall Television

This autumn two noteworthy series will premiere on public television. Companion books will be published for both.

"Space Age," a six-part series produced by WQED of Pittsburgh and the Japanese Public Television Network in association with the National Academy of Sciences, examines how society has been transformed since Sputnik and the birth of spaceflight. Beginning October 12, 8 p.m. EST, on PBS.

"Frontiers of Flight" has been co-produced by the National Air and Space Museum and the Discovery Channel. The 13-part series recounts the 90-year history of aviation and includes an in-depth look at the National Air and Space Museum's collection of aircraft. Beginning October 3, 8 p.m. EST, on the Discovery Channel.

Fellowships Available

The National Air and Space Museum sponsors a one-year resident Guggenheim Fellowship for aviation and space research and the A. Verville Fellowship, a 9- to 12-month fellowship focusing on the history of aviation or space studies.

Eligibility:
Guggenheim: Predoctoral applicants should have completed course work and exams and be engaged in dissertation research. Postdoctoral applicants preferably should have received Ph.D.'s within the past 7 years. **Verville:** All candidates with research and writing skills. Advanced degrees not required.

Awards:
Guggenheim: predoctoral, $13,000; postdoctoral, $21,000. **Verville:** 12-month fellowship: $26,000.

Contact:
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Washington, DC 20560
attn.: Cheryl Bauer (202) 357-1529

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Notification by: April 30
Beginning dates: Between July 1 and October 1

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New from Smithsonian Institution Press

At the Edge of Space: The X-15 Flight Program *by Milton O. Thompson, foreword by Neil A. Armstrong.* The first full-length account of the X-15 program, this book also includes profiles of the 12 test pilots. The author is chief engineer at the NASA Ames-Dryden Flight Research Facility in Edwards, California.

Silent Wings at War: Combat Gliders in World War II *by John L. Lowden, foreword by Walter Cronkite.* The author, an assault glider pilot with the First Allied Airborne Army in Europe, recounts the glider operations in which he and 39 fellow aviators participated, as well as the history of U.S., British, and German glider programs in World War II.

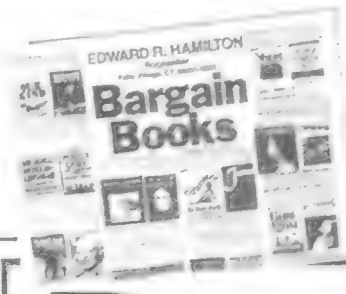
Segregated Skies: All-Black Combat Squadrons of World War II *by Stanley Sandler.* A military historian examines how the black aviators known as the Tuskegee Airmen and the U.S. Air Force paved the way toward racial parity.

Test Pilots: Riding the Dragon *by Martin Strasser Caidin. Bantam Air & Space Series #21, 1992. 360 pp., $4.99 (paperback).*

If your perception of a test pilot is a silver-suited warrior thundering off in afterburner, *Test Pilots: Riding the Dragon* will remind you of the men who flew into the unknown just by getting airborne.

Aviation writer Martin Caidin, who has over 140 books to his credit, divides this latest effort into two parts. Part one starts with Greek mythology and the very first test pilots: Daedalus and Icarus. What follows is a quick history of those who attempted to conquer the air before the Wright brothers. *Test Pilots* flies highest when it chronicles these lesser known trailblazers of the wood, wire, and doped-linen era.

Part two starts with the early history of Ohio's McCook Field, which would later become part of the huge flight test center at Wright-Patterson Air Force Base. Caidin writes in a conversational style, and the history becomes increasingly anecdotal as the narrative moves toward the present. He occasionally switches to a



first-person voice to tell the reader about Herb Fisher, Harold Silver, and other less famous test pilot pals. This proves to be as much a distraction as an asset.

Aviation buffs should enjoy this book. But what is the dragon that Caidin refers to in his title? He redefines the beast with each anecdote, perhaps suggesting that those who dare take to the high ground will eventually encounter their own dragons and get their tail feathers singed.

—D.C. Agle is a freelance writer living in Los Angeles.

Ladies in Waiting: A Pictorial Review of Davis Monthan AFB *by Scott Wonderly and Richard Dunham. Squadron/Signal Publications, 1991. 64 pp., b&w and color photos, $9.95.*

If you are curious about Davis Monthan Air Force Base—the government's boneyard for old surplus warplanes—you can go to Tucson, Arizona, and walk the rows of airplanes in the heat and the dust. But it's easier and a lot more comfortable to stroll through the dozens of photographs in this picture book.

—George C. Larson is editor of Air & Space/Smithsonian.

New IMAX film

The latest IMAX film, *Fires of Kuwait,* will come to the National Air and Space Museum this October. The 35-minute film, shot in Kuwait after the country's liberation in 1991, is a fascinating depiction of a massive firefighting effort. Firefighters representing 10 countries were involved in extinguishing and controlling more than 700 burning oil wells. The oil fires were put out in nine months, years earlier than first predicted.

Calendar

October 2–4
"Wings in Autumn" International Air Show & Fly-In. Courtland Air Base, AL, (205) 637-2215.

October 3 & 4
Fly-In and Fly-Market. Sponsored by the Experimental Aircraft Association's Antique/Classic Chapter 7. Sussex Airport, Sussex, NJ, (201) 361-8789.

Parks College Open House. Airshow, fly-in breakfast, antique and experimental aircraft. Parks College of St. Louis University, Cahokia, IL, (618) 337-7575.

"Wings Over Houston" Airshow. Blue Angels, North American Aerobatic Team, wingwalking. Ellington Field, Houston, TX, (713) 531-9461.

October 3–November 8
"The View From Space: American Astronaut Photography." Smithsonian Traveling Exhibition. Center for Cultural Arts, Gadsden, AL, (205) 543-2787.

October 10
Aviation Fly-Market & Swap Meet. Airplanes, radios, accessories. Franklin County Airport, Mt. Vernon, TX, (903) 725-6674.

Biplane Fall Classic. Sponsored by the Experimental Aviation Association's Chapter 690. Antique, classic, and contemporary biplanes. Stone Mountain Airport, Atlanta, GA, (404) 413-7112.

October 10–November 8
"Steichen and His Men: A Photographic Portrait of World War II." Adirondack Community College, Queensbury, NY, (518) 793-4491.

October 16–18
Midwest Space Development Conference. Celebrating the International Space Year. NASA programs, SETI, virtual reality. Worthington Holiday Inn, Columbus, OH, (614) 885-3424.

November 7 & 8
"Wings of Warmth" Fly-In. Clothing and food drive, aviation exhibits. Kutztown Airport, Kutztown, PA, (215) 838-9942.

November 14 & 15
Thunderbird Balloon Classic. Airshow, fireworks, displays of antique, military, modern aircraft. Glendale Municipal Airport, Glendale, AZ, (602) 978-7208.

Credits

Slightly Irregulus. O.H. Billmann spent 46 years in aviation before retiring to Simi Valley, California.

Astronomy's Most Wanted: Series Introduction. Laurence A. Marschall, a columnist for *The Sciences,* is a professor of physics at Gettysburg College.

The Planet Hunters. Billy Goodman writes about science from his home in Montclair, New Jersey.

The Battle Over the Rim. David Savold is an associate editor at *Air & Space/ Smithsonian.*

Leap of Faith. Tom Harpole, a freelancer from Avon, Montana, writes essays on subjects from bull riding to dynamiting and has been published in *Sports Illustrated* and *Outdoor Photographer.*

Terror in the Skies! Karen Jensen is an associate editor at *Air & Space/ Smithsonian.*

Live, from the Cape. Robert J. Donovan was involved in space reporting as the Washington, D.C. bureau chief of both the *New York Herald Tribune* and the *Los Angeles Times.*

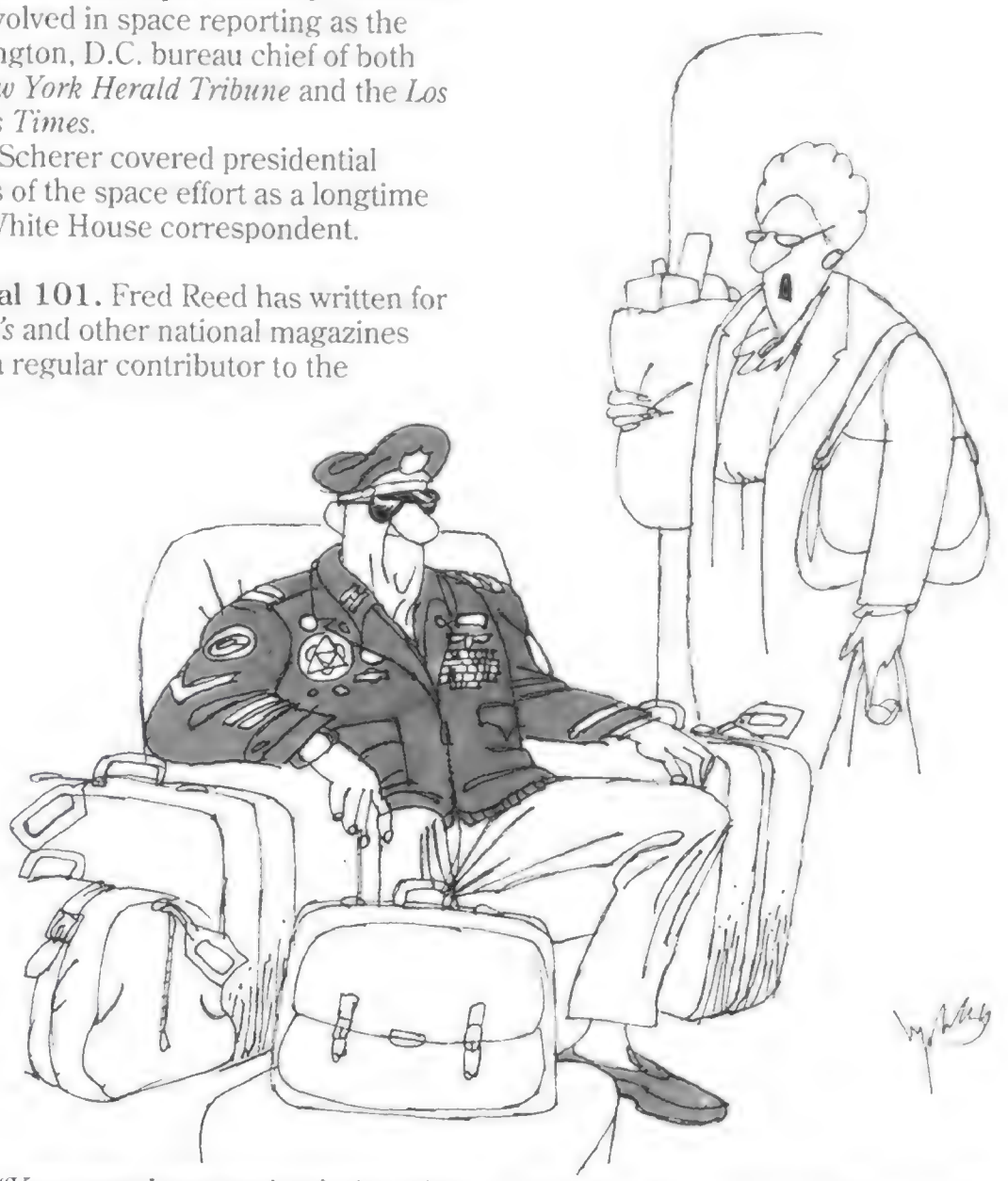
Ray Scherer covered presidential aspects of the space effort as a longtime NBC White House correspondent.

Survival 101. Fred Reed has written for *Harper's* and other national magazines and is a regular contributor to the *Washington Times.* He is also the author of this issue's Above & Beyond.

SETI Takes the Hill. William Triplett is co-author of *Drug Wars: An Oral History from the Trenches,* published this year by William Morrow. His last article for *Air & Space/Smithsonian* was "Going With the Flow" (February/March 1992).

"Gentlemen, I Give You the Whittle Engine." Daniel Ford wrote the controversial and award-winning *Flying Tigers: Claire Chennault and the American Volunteer Group,* published by the Smithsonian Institution Press. In addition to the individuals named in the article, Rick Leyes and Virginia Dawson contributed to Ford's narrative of technology transfer.

Space Cowboys. Wes Eichenwald, a Boston-based writer, has contributed to Soundings and Collections. His last piece for *Air & Space/Smithsonian* was "A Museum of Modest Proportion" (June/July 1991).



"Your squadron reunion isn't until next week. Aren't you ready a little early?"

"The Satellite Sky" Update/32

These regular updates to "The Satellite Sky" chart will enable readers to keep their charts up to date. Additions can be clipped and affixed to the chart at the appropriate altitude.

New launches

90 to 300 MILES

Cosmos 2203
7-24-92 PL

Cosmos 2207
7-30-92 PL

Eureca
7-31-92 KSC

FSW-2
8-9-92 SHU

Soyuz TM-15
7-27-92 TT

300 to 630 MILES

Cosmos 2195
7-1-92 PL

Sampex
7-3-92 VAFB

630 to 1,250 MILES

Cosmos 2197-02
7-13-92 PL

Kitsat-A
8-10-92 KOU

S80-T
8-10-92 KOU

Topex/Poseidon
8-10-92 KOU

6,200 to 13,700 MILES

Cosmos 2204-06
7-30-92 TT

GPS-14
7-7-92 CAC

21,750 to 22,370 MILES

DSCS-3
7-2-92 CAC

Eutelsat II-F4
7-9-92 KOU

Gorizont 26
7-14-92 TT

Insat 2A
7-9-92 KOU

Intelsat K
6-9-92 CAC

Deletions

90 to 300 MILES

Cosmos 2185
down 6-11-92

Cosmos 2186
down 7-24-92

Delta Star
down 6-23-92

Progress M-12
down 6-27-92

Rohini
down 7-14-92

300 to 630 MILES

Cosmos 1985
down 5-4-92

Launched but not in orbit

90 to 300 MILES

Progress M-13 CIS research	6-30-92	down 7-24-92
Resurs-F15 CIS earth sensors	6-23-92	down 7-9-92
STS-50 U.S. research	6-25-92	down 7-9-92
STS-51 U.S. research	7-31-92	down 8-8-92

DATA: SAUNDERS KRAMER

Forecast

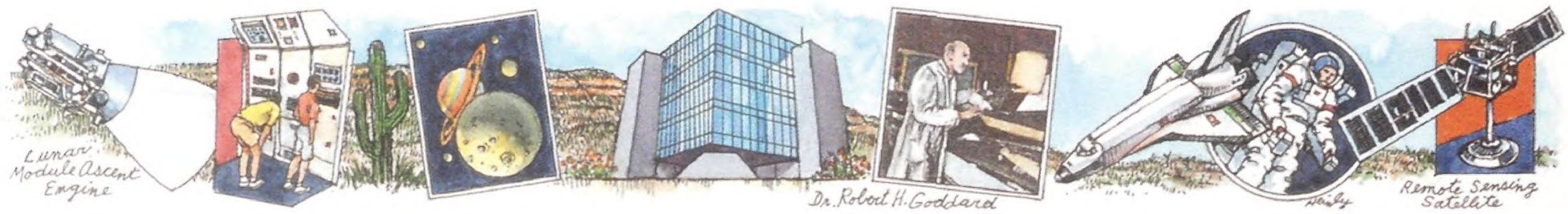
In the wings...

When the Air Circus Comes to Town. When you fly precision aerobatics in airshows across the country, you need a certain flexibility. As Daniel Heligoin and Montaine Mallet of "The French Connection" will tell you, an airshow performer's life is never dull.

From Dust to Dust. Astronomers believe they understand how stars die, but they are puzzled by the mechanism of star birth. What forces transform a cloud with a fraction of the density of air into a sphere producing heat and light? Two generations of scientists seek the answer.

Rescue From the Ice. Fifty years after a convoy of P-38s and B-17s was stranded on a Greenland glacier, adventurers pull them from an icy grave.

Testing Einstein. In the most audacious experiment ever planned for space, a satellite called Gravity Probe B will attempt to either prove or disprove Einstein's general theory of relativity.



JOHN HEINLY

Space Cowboys

Alamogordo is a cowtown with a difference. Historically tied to nearby Holloman Air Force Base and the White Sands Missile Range, the desert city is littered with old rockets, a Space Age version of the junked cars scattered about other rural settings. Pigeons socialize on rusting missiles mounted on the Chamber of Commerce building. The Star Motel and the Satellite Inn, complete with blinking neon atom, share sidewalks with the 21st Century Hockshop.

The 1960s motif doesn't prepare you for the area's premier attraction. Set in the foothills of the Sacramento Range and visible for miles, the Space Center, formerly the International Space Hall of Fame, is housed in a gleaming bronze-tinted glass cube, below which Alamogordo sprawls panoramically across the Tularosa Valley. Sprouting among the cacti and yuccas surrounding the museum is a garden of rockets, dominated by the 88-foot-high Little Joe II, which served as a test bed for the Apollo launch escape system.

On a recent morning, space center director J. Edson Way, an amiable man with a ready smile, sat in his sun-washed office in purple shirt and bolo tie and discussed the center's niche in space history. When people think of the origins of America's space program, he says, they think of Florida or Houston. "They don't realize that the early experiments in rocketry took place here in southern New Mexico, in Roswell and Alamogordo, going back to the 1920s." With its clear skies, flat expanses, and sparse population, you don't have to be a rocket scientist to deduce why this has been hospitable territory for space cowboys since the days of Robert Goddard, the father of modern rocketry.

The space center's history is more recent. In 1973 businessman and former Alamogordo mayor Dwight Ohlinger was inspired to create a space pioneer hall of fame after seeing a commercial for the Football Hall of Fame. Ohlinger lined up other boosters, state legislators, and the governor, and three years later, with Wernher von Braun as honorary chairman of the inaugural committee, the International Space Hall of Fame was dedicated on Goddard's birthday. (It was renamed Space Center in 1989 to reflect an expanded facility and focus.) Exhibit loans from NASA and the fledgling National Air and Space Museum helped get things rolling, as did outright gifts; in the mid-1970s, old rockets were viewed more as scrap metal than as artifacts.

The Space Center, P.O. Box 533, Alamogordo, NM 88311. Phone (505) 437-2840 in New Mexico, (800) 545-4021 out of state. Open daily 9 a.m. to 6 p.m. except Christmas. Admission $2.25 adults; $1.75 children, seniors, and military.

Though internationally focused, the space center retains idiosyncratic, boosterish touches, such as a gallery of New Mexico space pioneers and a display of clips and souvenirs from its own founding. Portraits of the 111 Hall of Famers, from Galileo to Sally Ride, and biographical texts are hung throughout the building. Five inductees are added yearly, voted in by the Space Center Commission after recommendations by the likes of the International Astronautical Federation, NASA historians, and the National Air and Space Museum.

Visitors start at the top of the four-story cube and stroll to the ground floor via graded walkways, passing such Apollo memorabilia as a glove Neil Armstrong wore on his moonwalk and the model of the lunar hemisphere that hung behind Walter Cronkite as he broadcast the epic event back on Earth. There's a walk-in module of an optimistically dated "Space Station 2001" featuring a female mannequin in a blue NASA jumpsuit posed at the duty station.

The museum is big on details, both technical and personal. Shuttle 'nauts, we can infer from an exhibit, brush with Crest and use Dial Solid antiperspirant and Keri hand lotion. A Skylab toilet is displayed behind plexiglass.

On the first floor, kids walk on Mars, a room bathed in dim red light with a mockup of part of a Mars rover. Exit to moonrock. An overview of the planets is somewhat dated ("In 1989, Voyager 2 will observe Neptune..."), but on the whole, the center blends education and entertainment seamlessly.

One Hall of Famer, retired Air Force colonel John Stapp, who has served on the center's board since Day One, is a living link to early manned-flight research. Stapp pioneered high-G deceleration experiments and supervised the Manhigh program in the 1950s, in which subjects rode balloons up to 100,000 feet. Listening to tapes of Stapp, 82, spin stories in his Southwestern drawl is eavesdropping on oral history of a high order.

The center also features a planetarium, which is named for Clyde Tombaugh, the man who discovered Pluto in 1930 at age 25 and still drops by the museum. On a recent Saturday night, a young crowd gathered at the planetarium for a laser show set to the high-decibel music of heavy metal bands Slaughter and Firehouse. "The more you get involved, the better the show will be," laserist Mike Turner advised the audience, which whooped and applauded the bursts of blinding light. Stapp and Way credit Gregory Kennedy, director from 1985 to 1990, for transforming a portrait gallery with rockets into a multi-media center that attracts 120,000 visitors annually.

The Space Center is obsessed with community involvement. It's hosted a Valentine's Day moonlight champagne buffet and laser show, as well as contests involving space food cooking. Way has mapped out a master plan for the next 10 years. "For perhaps cute reasons," he says, "the state designated the road leading up to the space center as New Mexico Highway 2001." Stapp foresees a park and a tramway and "enough activities to get [visitors] to stay in Alamogordo overnight, to the delight of all the motels."

—Wes Eichenwald

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